A SOCIO-ECONOMIC ASSESSMENT OF ONTARIO WASTE MANAGEMENT INITIATIVES

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A SOCIO-ECONOMIC ASSESSMENT OF ONTARIO WASTE MANAGEMENT INITIATIVES

Report prepared for:

The Ontario Ministry of the Environment
Fiscal Planning and Economic Analysis Branch

Report prepared by:

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In association with:

Econometrics Research Limited

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ACKNOWLEDGEMENT AND DISCLAIMER

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Executive summary

In recognition of the need for more comprehensive information on waste generation, the 3R's and the effects of different policy measures, the Fiscal Planning and Economic Analysis Branch of the Ministry of the Environment commissioned four solid waste management studies. The present study synthesizes the findings of all these studies.

Purpose

The purpose of this study is to coordinate and synthesize the individual waste management studies and to assess the costs, benefits and consequences of waste management policy options. There are three specific objectives:

1. To coordinate the individual components of the socio-economic studies;

2. To define scenarios for the analysis and evaluation of the waste management objectives; and

3. To provide estimates of the economic impacts of these scenarios and their consequences for achieving or exceeding the waste management objectives announced by the Minister of the Environment on, March 10, 1989, "Ontario will divert to constructive use 25 per cent of its household and commercial-industrial waste by 1992, and 50 per cent by the year 2000."

Scope and methods

The report provides the following information:

- synthesis of the other three studies commissioned by the Ontario Ministry of the Environment;

- description of the waste management policy model developed by the study team for the analysis of the impact different waste management policies have on the generation and diversion of municipal waste in Ontario;

- description of eighteen policy options and their impacts on waste generation and diversion in Ontario;

- definition and analysis of a current trend scenario and four illustrative policy scenarios for waste generation and diversion in Ontario for the years 1992 and 2000; and

- analysis of the provincial and regional macroeconomic impacts of the current trend, the four waste diversion scenarios and the possible implications of reduced exports of newsprint and pulp in 1992 and 2000.

Coordination and synthesis

Coordination of the individual components was achieved primarily through frequent meeting of those responsible for each study and staff of the Ministry of the Environment.

The primary method by which a synthesis of the component studies has been achieved is through the utilization of information from each of the studies in the waste management policy model (WMPM) to develop waste diversion policy scenarios for achieving the 1992 and 2000 waste diversion targets.

Source Document	Information Obtained
CH2M Hill/MacLaren (1991)	Waste generation in 1987 and 1989
CH2M Hill/MacLaren (1991)	Costs of incineration, landfill, MRFs
RIS/VHB (1991)	Waste generation in 1989
RIS/VHB (1991)	Current trends in generation and 3R's
RIS/VHB (1991)	Prices of secondary materials
VHB/MacLaren (1991)	Efficacy of economic measures

The waste management policy model estimated the waste management costs and diversion potential of five scenarios: 1) current trend, waste diversion initiatives in Ontario as of, December 31, 1990; 2) regulatory components of the Waste Reduction Action Plan, actions announced by the Minister of the Environment in February, 1991; 3) economic measures, market based policy instruments for diverting waste; 4) regulatory measures, command and control measures which build upon WRAP; and 5) selected combination of regulatory measures. The scenario results presented in this report do not represent the full range of possible policy options to achieve the waste diversion targets. The WMPM can be used to develop additional scenarios.

The results from the WMPM were used to estimate the provincial macroeconomic impacts of the waste diversion policy scenarios relative to the current trend. An additional scenario of the macroeconomic impacts of a reduction in pulp and newsprint exports, due to trends in the United States, was developed for comparison with the impacts of the waste diversion policy scenarios.

Socio-economic impacts

The total waste management costs presented in this report are the cost of waste management plus any incremental program costs. All incremental program costs and costs of collecting and disposing of residential waste are paid by the public sector. IC&I and recycling costs are paid by both the public and the private sectors. The regulatory measures and the selected combination of economic and regulatory measures scenarios achieve both the 1992 and the 2000 waste diversion targets. The increased cost of waste management using only regulatory measures to achieve the 1992 target is about $60 million (1989$) while the increase in waste management costs in achieving the 2000 target using just regulatory measures is $105 million (1989$). The selected combination of economic and regulatory measures scenario increases waste management costs by $42 million in 1992 and $46 million in 2000. The economic measures scenarios and the WRAP scenario achieve only the 1992 target. The economic measures scenario decreases waste management costs by $5 million and the WRAP scenario increases costs by $36 million in 2000. The economic measures scenario is the only scenario where waste management costs decrease in 2000. This is the result of a shift of the costs of waste management from the public sector to the private sector, less emphasis on recycling than in the other scenarios and a greater amount of source reduction.

The four waste diversion scenarios do not have a significant macroeconomic impact on the Ontario economy although each scenario results in a slight decrease in economic activity due to reduced demand for provincial output in both 1992 and 2000 relative to the current trend. The decrease in economic activity is the result of lower labour income arising from decreased employment, particularly in Northwestern Ontario. The results reflect the relatively small size of the solid waste management sector in the Ontario economy, less than $1 billion (1989$) in total direct expenditures for both 1992 and 2000. Also, the four waste diversion policy scenarios have little effect on the actual amount of public and private sector expenditures on waste management but do change the relative distribution of these expenditures between waste disposal and 3R's activities. All four waste diversion policy scenarios have the same relative impact on the provincial value added, labour income, taxes and person years of employment in both 1992 and 2000.

Levels of employment are marginally sensitive to the waste diversion policy scenarios. A 25 per cent reduction in exports of newsprint and pulp, due to trends in the United States, results in a loss of 27,000 person years in 1992 (0.5 per cent of total employment) and a

50 per cent reduction in exports of newsprint and pulp results in 58,000 person years lost in the year 2000 (one per cent of total employment).

The four waste diversion policy scenarios reduce employment by a relatively modest amount of about 5,000 jobs (0.10 per cent of total employment). This magnitude does not vary much between 1992 and 2000. The employment losses are the result of shifts in market demand from primary materials to secondary materials. These losses are shared by all sectors and regions of the provinces, excluding the transport sector of Central Ontario which gained employment as a result of the four waste diversion scenarios. Transportation is the only sector in which an increase in employment results from the scenario analysis, excluding the economic measures scenario, in 2000.

A reduction in exports of newsprint and pulp reduces employment throughout the economy and regions, but its most severe impacts are concentrated in the paper, forestry, and wood industries, and in Northwestern Ontario. The four waste diversion policy scenarios result in minor changes in employment between industrial sectors and regions relative to the current trend scenario. The industrial sectors which experience the largest change in employment are textiles, knitting and weaving and agriculture, with Northwestern Ontario being the hardest hit region.

Recommendations

The following recommendations are based on the three previous waste management studies and the economic analysis undertaken in this study, and do not necessarily reflect MOE policy.

Comprehensive records of waste disposed of or received at landfills, incinerators and recycling facilities have not been maintained in Ontario, hence reliable waste generation and diversion information is not available for many locations in the Province. Many Ontario municipalities are now undertaking studies to better define the components of the waste stream and the social costs and revenues of options available for waste management. There is also little monitoring of secondary materials markets. This information should be collected in a consistent manner by all municipalities and placed in a central database.

Municipalities should expand the Blue Box Program beyond the traditional four materials (newspaper, glass, metal and PET). Some municipalities have included corrugated cardboard, phone books and household hazardous waste in their programs. Other municipalities are experimenting with including film plastic, boxboard, magazines and fine paper in their programs.

A surcharge should be placed on tipping fees to cover (some) external social costs, and to provide funds for closure and post–closure care. Tipping fees should be raised at landfills

where these fees are lower than the cost of managing the waste. Facility management costs should include all management aspects.

The macroeconomic impacts of the waste diversion policy scenario analysis are marginal. The most significant impact of the policy scenarios is in the distribution of costs and benefits between regions and industrial sectors of the Province. Detailed sectoral and regional analysis of these impacts, particularly on northern Ontario and the forestry/forest products industries, is required.

The provincial economy is sensitive to the waste management policies adopted by its major trading partners. Research should be undertaken to develop a comprehensive information base of the current and planned waste management policies of Ontario's major trading partners and their possible affects on Ontario's export markets.

Reductions in employment associated with recycling policies are the result of two opposing forces. A positive force resulting from increased activity in collecting, sorting and recycling and a negative force emanating from the increase in costs of recycling activities that must be met by reducing other expenditures. All the recycling scenarios considered in this study allocate the costs of waste management to the respective sectors. Households respond by cutting consumption, businesses by cutting investment expenditures and governments by reducing overall expenditures. Further research into these changes and shifts in economic activity resulting from recycling and other waste diversion activities are required to successfully develop secondary materials markets and to implement worker retraining or business investment programs in the industrial sectors adversely effected.

Abbreviations

3R's	Reduce, reuse and recycle
CTC	Consumption tax credits
GDP	Gross domestic product
HDPE	High density polyethylene
HHW	Household hazardous waste
IC&I	Industrial/commercial/institutional
IMC	Input matrix category
ITC	Investment tax credits
kg	kilograms
MOE	Ontario Ministry of the Environment
MRF	Material recovery facility
MSRP	Municipal Recycling Support Program
MSS	Mandatory source separation
MSW	Municipal solid waste
NAPP	National Packaging Protocol
OCC	Old corrugated cardboard
OMMRI	Ontario Multi-Material Recycling Initiative
ONP	Old newspapers
PET	Polyethylene
RPC	Rigid plastic containers
t	tonne (1000 kg)
U.S.	United States
USD	U.S. dollars
WMPM	Waste management policy model
WRAC	Waste Reduction Advisory Committee

1 Introduction

1.1 Background

The growing economic prosperity of Ontario in the 1980's was accompanied by increases in the generation of waste requiring disposal. At the same time, landfill and incineration capacity in the province has not kept pace and the difficulty of finding acceptable new sites underscores the importance of alternatives to the traditional means of disposal.

Over the past few years the Provincial government has explored many ways of improving waste management in Ontario. For example, in the early 1970's a Task Force on Solid Waste made recommendations on regulatory initiatives for beverage containers which were adopted by the government. Also, on the advice of the Task Force, the Waste Management Advisory Board was established to provide advice on solid waste management to the Minister of the Environment. Later this Board was superseded by the Recycling Advisory Committee. Then, in November 1990, this Committee was re-named the Waste Reduction Advisory Committee and the Committee's mandate was modified to reflect a greater emphasis on reduction.

In 1981 the Ministry of the Environment announced its source separation program and the *Blueprint for Waste Management in Ontario* was released in 1983. Each municipality can voluntarily prepare a Waste Management Master Plan for which provincial funding is available. Recycling depots have been set up in urban centres with provincial support and the *Blue Box* program has been received enthusiastically by the public.

A common theme running through each of these programs has been the attempt to reduce the amount of waste going to landfill or incineration. In March 1989 the Minister of the Environment announced Provincial goals for diverting wastes from disposal for 1992 and 2000. These goals were endorsed by the new Minister in *An Ontario Waste Reduction*

Action Plan that was released in February 1991. This plan consists of several components including increased emphasis on source separation, a requirement for waste audits and waste reduction plans by major users of packaging materials, mandatory recycling in all but the smallest municipalities, mandatory community composting facilities, enhancements to the *Blue Box* program, reduced red tape for the approval of 3R's facilities, an aggressive marketing strategy for source separated materials, a public education program, an environmental audit of the Government's activities and the creation of a Waste Reduction Office in the Ministry of the Environment.

In recognition of the need for more comprehensive information on waste generation, the 3R's and the effects of different policy measures, the Fiscal Planning and Economic Analysis Branch of the Ministry of the Environment commissioned four studies in 1990:

- *The Physical and Economic Dimensions of Municipal Solid Waste Management in Ontario* (CH2M Hill and Maclaren Engineers 1991);
- *Market Assessment of 3R's Activities in Ontario* (RIS and VHB 1991)[1];
- *True Costs of Municipal Waste Management* (VHB and Maclaren Engineers 1991)[2]; and this study,
- *A Socio-Economic Assessment of Ontario Waste Management Initiatives.*

This report provides a description of the Waste Management Policy Model (WMPM) developed to examine alternative policy scenarios for meeting the government's waste diversion targets. The model provides an innovative and flexible approach to the analysis of waste management policy.

The report also includes a description of a provincial input-output model that was modified specifically to estimate the macroeconomic impacts of waste management policies. In some ways, this macroeconomic model is even more path breaking than the waste management model since it is the first such model to explicitly include a waste management sector and recycled materials in an articulated representation of an economy.

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[1] Published in 1992.

[2] Published in 1992.

1.2 Purpose and objectives

The purpose of this project is to coordinate and synthesize the individual waste management studies and to assess the costs, benefits and consequences of waste management policy options.

There are three specific objectives :

1. To coordinate the individual components of the socio-economic studies;

2. To define scenarios for the analysis and evaluation of the waste management objectives; and

3. To provide estimates of the trade-offs and their consequences of achieving and/or exceeding the waste management objectives.

1.3 Coordination of the individual components of the socio-economic studies

Coordination of the individual components was achieved primarily through frequent meeting of those responsible for each study and staff of the Ministry of the Environment. After each meeting, detailed notes were circulated to provide a written record of what was agreed to and how the work on each component study was expected to proceed. Also, shortly after the studies began, a detailed "logic diagram" of the individual components showing their inter-relationships was prepared to guide each of the studies. A copy of this diagram is included in Appendix E.

One of the most important coordination tasks was to ensure that similar assumptions and a common data set were used by all participants. To a large extent, this was successful. However, in such a rapidly changing field, where new information is being made available almost daily, it is inevitable that studies which were completed sooner present information that is superseded in later studies. This was most pronounced in the differences that emerged in estimates of waste generation contained in CH2M Hill and MacLaren Engineers (1991) and Resource Integrated Systems and VHB Research and Consulting (1991), the latter effectively completed five months after the former.

For the purposes of this study, it was necessary to compare the estimates from both of these studies and to use the waste generation estimates that seem to be more reliable. This comparison is presented in section 5.1 dealing with current trend.

The primary method by which a synthesis of the component studies has been achieved is through the utilization of information from each of the studies in the waste management policy model. This is summarized in Table 1.

Table 1
A summary of information obtained from the component studies

Source Document	Information Obtained
CH2M Hill/MacLaren (1991)	Waste generation in 1987 and 1989
CH2M Hill/MacLaren (1991)	Costs of incineration, landfill, MRFs
RIS/VHB (1991)	Waste generation in 1989
RIS/VHB (1991)	Current trends in generation and 3R's
RIS/VHB (1991)	Prices of secondary materials
VHB/MacLaren (1991)	Efficacy of economic measures

1.4 Defining the targets

On March 10, 1989 the Minister of the Environment announced that "Ontario will divert to constructive use 25 per cent of its household and commercial-industrial waste by 1992, and 50 per cent by the year 2000." Announcing a new Waste Reduction Action Plan in February 1991, the new Minister reiterated the target, "The province's waste reduction action plan is intended to divert from disposal, at the very least, 25 per cent of our waste by 1992 and 50 per cent by the year 2000."

There are various ways of interpreting these targets. Two that were considered in detail were:

i) the amount (in tonnes) of waste diverted should be at least 25 per cent in 1992 and 50 per cent in 2000 of the waste going to landfill and incineration in 1987 (adjusted for population growth);

ii) the amount (in tonnes) of waste landfilled and incinerated should be at least 25 per cent in 1992 and 50 per cent in 2000 less than the waste going to landfill and incineration in 1987 (adjusted for population growth).

After lengthy discussions with Ministry staff and all of the project consultants it was agreed that the second interpretation, which focuses on quantities of waste disposed of at landfills and incinerators rather than the amount of waste diverted, is preferable because it provides a simpler basis for measurement and verification. It is necessary only to measure waste quantities sent to landfill and incineration in 1987, 1992 and 2000 to see whether the targets are met (subject to a small adjustment for population increase).

The first interpretation of the targets is much more difficult to make operational since it requires an estimate of the waste handled by the 3R's, including reduction. Furthermore, the second interpretation is more consistent with the rationale for the diversion targets which is to divert waste from disposal. It also avoids counting as success the awkward possibility of a future *increase* in waste sent to landfill and incineration even if the 3R's succeed in dealing with 25 per cent and 50 per cent respectively of the 1987 quantities. This could happen if the total waste generated increased significantly faster than the population from 1987 to 2000.

Having clarified the sense in which the targets have been interpreted in this study, two additional comments are in order. First of all, the targets are understood to apply to waste *tonnage* rather than waste *volume*. If the composition of the waste stream changes over time, fulfilment of the targets measured as tonnes may not necessarily mean that the targets are fulfilled measured as volumes.

Second, the targets are understood to be *provincial* and to apply to the *aggregate* of all municipal wastes. This means that individual municipalities may do better or worse than the targets and that performance of individual components of the waste stream may be greater or less than the targets and yet the targets can still be met.[3]

In quantitative terms, the interpretation given to the provincial targets in this study are illustrated in Table 2. These targets are adjusted for population growth estimates.

This interpretation of the provincial waste diversion targets requires that 3R's be sufficient to reduce the quantity of waste sent to landfill and incineration by 1.7 million tonnes in 1992 and 3.8 million tonnes as compared with 1987.

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[3]However, in *The Waste Crisis in the Greater Toronto Area*, Ministry of the Environment, June 1991, it is strongly suggested that the Provincial targets also apply to the GTA region: "...when the GTA reaches the provincially mandated targets (at least 25 per cent by 1992 and at least 50 per cent by the year 2000)...(p.3)

Table 2
Quantification of the waste diversion targets

Year	Waste Sent to Landfill and Incineration (tonnes)
1987	9,093,384[1] - actual
1992	7,372,100 - target
2000	5,343,388 - target

[1] CH2M Hill 1991.

1.5 Methodology

Two simulation models were developed in this study. The first, which was designed and implemented from scratch, starts from a set of current waste generation and management trends which estimate the types and quantities of wastes that will be generated, dealt with by the 3R's and disposed in 1992 and 2000. The current trend assume no new policy initiatives after December 31, 1990.

The Waste Management Policy Model (WMPM) allows various policy measures, alone or in combination, to be invoked, each of which can affect any or all of the 22 components of the residential and industrial, commercial, and institutional (IC&I) waste streams that are assessed. Where appropriate, the implementation costs of a measure are provided. These costs are the *additional operating and capital implementation costs incurred by the Province*. The costs of capitalizing and operating the total solid waste management sector are paid by municipalities and the private sector; these costs are calculated separately by the WMPM. The model also estimates the costs and revenues associated with the outcome of each of the policy measures.

A detailed description of this model is given in Chapter 4 and a "user's guide" is provided in Appendix B.

The second model is an extension of an existing input-output model of the Ontario economy. Both the original input-output model, which operates at the county level or any aggregation of counties, and the extended version, which also incorporates a waste management sector, were developed by Econometrics Research Limited (ERL). The model is unique with respect to its high degree of spatial resolution and also because of its explicit inclusion of a waste management sector that recycles materials and supplies them to industries which use them as inputs in the production of products.

A description of the modified input-output model is presented in Chapter 6.

Using these two models, the implications of four waste diversion policy scenarios were assessed. These scenarios are described as:

1. Regulatory components of the Ontario Waste Reduction Action Plan (WRAP) (Ministry of the Environment, February 1991).

2. Economic (all measures affect behaviour through various financial incentives/disincentives).

3. Regulatory (all measures directly regulate behaviour).

4. Selected combination of economic and regulatory measures (made up of some selected economic and some selected regulatory measures).

The regulatory and combined scenarios are extensions of WRAP.

1.6 Data sources

Virtually all of the data on waste management used in this synthesis study were obtained from the other component studies by CH2M Hill and MacLaren Engineers (1991), Resource Integrated Systems and VHB Research and Consulting (1991) and VHB Research and Consulting and MacLaren Engineers (1991). Additional information on the effectiveness of different policy measures and on pulp and paper technologies was obtained from a literature review (see Appendix A).

1.7 Main findings

The main findings from the analytical components of this study are summarized in Table 3 and Table 4. A more detailed discussion of the results is presented in Chapter 5 and Chapter 7. Detailed results of the analytical components of this study are found in Appendix C.

The total waste management costs presented in this report are the combined public and private sector cost of waste management plus the incremental public sector program cost of the policy scenario. Residential waste-management costs are assumed to be paid by the public sector while IC&I and recycling costs are paid by both the private and public sectors.

The regulatory measures and the selected combination of economic and regulatory measures scenarios achieve both the 1992 and 2000 waste diversion targets. The increased

cost of waste management using regulatory measures to achieve the 1992 target is about $60 million (1989$) while the increase in waste management costs in achieving the 2000 target using regulatory measures is $105 million (1989$). The selected combination of economic and regulatory measures scenario increases waste management costs by $42 million in 1992 and $46 million in 2000.

Table 3
Summary of the waste diversion policy scenarios waste diversion potential and costs

Scenario	Per cent of waste diverted		Increase in the total cost of waste management (000,000 1989$)	
	1992	2000	1992	2000
Ontario's waste reduction action plan	25%	36%	$21	$36
Economic measures	25%	37%	$2	($5)
Regulatory measures	33%	47%	$60	$105
Selected combination of economic and regulatory measures	37%	48%	$42	$46

Note: Total waste management costs include the implementation costs of measures.

Source: Chapter 4.

The economic measures scenario and the WRAP scenario achieve only the 1992 target. The economic measures scenario decreases waste management costs by $5 million and the WRAP scenario increases costs by $36 million in 2000. The economic measures scenario is the only scenario where waste management costs decrease in 2000. This is the result of a shift of the costs of waste management from the public sector to the private sector, less emphasis on recycling than in the other scenarios and a greater amount of source reduction.

The macroeconomic impacts of the four waste diversion scenarios relative to the current trend provide several results. First, the four scenarios have only a slight impact on the Ontario economy. For example, all of the scenarios reduce gross provincial output by only 0.5 per cent, or less than $3 billion (1989$) in 2000, with the economic measures scenario

Table 4
Summary of the macroeconomic impacts of the waste diversion policy scenarios relative to the current trend scenario, 1992 and 2000

Difference between waste diversion scenario and current trend, 1992 (billions 1989$)

Scenario	Gross output	Value added	Labour income	Taxes	Employment (person years)
Waste reduction action plan	($6.1)	($0.6)	($1.2)	($0.2)	(5,328)
Economic measures	($6.2)	($0.6)	($1.2)	($0.2)	(5,357)
Regulatory measures	($6.0)	($0.5)	($1.2)	($0.2)	(5,300)
Selected combination of economic and regulatory measures	($6.0)	($0.5)	($1.2)	($0.2)	(5,307)

Difference between waste diversion scenario and current trend, 2000 (billions 1989$)

Scenario	Gross output	Value added	Labour income	Total taxes	Employment (person years)
Waste reduction action plan	($2.7)	($0.4)	($1.1)	($0.8)	(5,869)
Economic measures	($2.9)	($0.5)	($1.1)	($0.8)	(5,919)
Regulatory measures	($2.5)	($0.3)	($1.0)	($0.8)	(5,819)
Selected combination of economic and regulatory measures	($2.6)	($0.3)	($1.1)	($0.8)	(5,858)

having a slightly greater negative impact than the other three policy scenarios and the regulatory measures scenario having a slightly less negative impact than the other scenarios. The economic measures scenario is the only scenario where the waste management sector is smaller in 2000, relative to the current trend. Second, the economic impact of all four waste diversion scenarios is less in the year 2000 by almost one-half relative to the year 1992. Third, combined provincial and municipal tax revenue are the only economic indicator resulting from the policy scenarios which are expected to be greater in the year 2000 than in the year 1992. Fourth, each scenario results in a decrease in economic activity in both years relative to the current trend. Finally all four policy scenarios have the same relative impact on the provincial value added, labour income, taxes and person years of employment in both target years. Fifth, the negative impact of the scenarios is relatively greater in Northwestern Ontario than the rest of the Province. The scenarios result in a positive economic impact in only one region, Central Ontario. Sixth, all economic sectors in the Province, except transportation, are negatively impacted by the four waste diversion policy scenarios. Increased economic activity in the transportation sector is the result of greater recycling in the Province.

The macroeconomic impacts on different industrial sectors and regions in the Province are discussed in Chapter 7.

1.8 Report structure

The report is structured as follows. Chapter 2 provides a synthesis of the other waste management studies undertaken for the MOE. Chapter 3 provides a description and definition of the waste management policy scenarios analyzed in this report. The structure, data requirements and output of the WMPM are described in Chapter 4. In Chapter 5 the results of the analysis of the policy scenarios using the WMPM model are presented. Chapter 6 describes the input-output model used to examine the macroeconomic impacts of the waste management policy scenarios on the Ontario economy and Chapter 7 summarizes the results of the macroeconomic analysis. Conclusions and recommendations are presented in Chapter 8. Chapter 9 is a detailed bibliography of the literature used in the study.

The report's appendices provide a detailed description of the waste diversion measures included in the policy scenario analysis, a description of the WMPM, detailed policy scenario and macroeconomic impact results and a logic diagram of the study components.

2 Waste management in Ontario: quantities, markets and costs[4]

This chapter provides a summary and synthesis of three studies that were undertaken for the Ontario Ministry of the Environment in 1990-1991:

> CH2M Hill Engineering Ltd. and MacLaren Engineers Inc. 1991. *The Physical and Economic Dimensions of Municipal Solid Waste Management in Ontario*. Toronto: Ontario Ministry of the Environment.
>
> Resource Integration Systems Limited and VHB Research and Consulting Inc. 1991. *Market Assessment of 3R's Activities in Ontario*. Toronto: Ontario Ministry of the Environment.
>
> VHB Research and Consulting Inc. and MacLaren Engineers Inc. 1991. *True Costs of Municipal Waste Management*. Toronto: Ontario Ministry of the Environment.

These studies represent a major effort on behalf of the Ontario Ministry of the Environment to substantially improve the information available for policy analysis in municipal solid waste (MSW) management.

[4] The material in this chapter is taken from the reports on which the chapter is based. Full acknowledgment of the work of CH2M Hill Engineering Ltd. (CH2M Hill), MacLaren Engineers Inc., Resource Integration Systems Ltd. (RIS) and VHB Research and Consulting Inc. (VHB), is given. To obtain further information about these studies, readers should review the individual reports of the various consultants.

The purpose of this chapter is to provide an overview of the objectives, methodologies and data sources and findings of each of these studies. As already noted, much of the information used in the present study to assess various means of achieving the Province's waste diversion goals comes from these other studies so it is important for readers of this report to appreciate the strengths and limitations of the information used in the assessment. Furthermore, it is also important to appreciate that all of these studies form an integrated set that gives an unprecedented opportunity to understand several key dimensions of the Ontario's waste management problem and its possible solutions.

2.1 The physical and economic dimensions of municipal solid waste management in Ontario[5]

2.1.1 Study objectives

In 1990 the Ontario Ministry of the Environment awarded CH2M Hill Engineering Ltd. and MacLaren Engineers a contract to develop a database on the physical and economic dimensions of municipal solid waste (MSW) management in Ontario. The objectives of the study were to:

- develop a complete picture of MSW management in Ontario in 1987 and 1989;
- use secondary data sources (i.e. published reports) to gather information on sources and quantities of MSW, facilities for its handling and disposal, and, public, private and so-called third sector activities in solid waste management; and
- summarize information on the physical and economic dimensions of MSW management in this report and also in a database format amenable to updating as more information becomes available.

The scope of the study was limited to MSW (i.e. non-hazardous material which is currently disposed at municipal landfills and incinerators). It also included material which is currently collected from the residential sector and recycled.

[5] This section is based on CH2M Hill and MacLaren Engineers, 1991.

2.1.2 Methodology and data sources

A comprehensive database including all aspects of solid waste management in Ontario was developed through an extensive review of waste management activities at the county, and where possible, the municipal level. The study divided data collection into two stages:

- waste generation; and
- the waste management system.

The waste quantity (generation, disposal, recycling) data collected are for 1987 and 1989, where available. Information on the quantity of municipal solid waste generated was gathered for the residential/light commercial sector and the IC&I sector for municipalities and regions in the province.

Residential waste generation rates were developed from *Waste Management Master Plans*, and residential waste generation rates derived from the Gore and Storrie (1990) studies on residential waste in East York and Fergus. For the IC&I sector, waste generation rates were determined for 25 industrial sectors (Input Matrix Categories) based on a number of industrial waste composition surveys conducted in Ontario and American municipalities.

The waste generation information was dis-aggregated into fourteen specific waste types derived from RIS (1991).

The waste management system in Ontario includes the following key players:

- landfills;
- incinerators;
- transfer stations;
- waste haulers;
- recycling programs;
- material recycling facilities; and
- recycling agents (recyclers).

Information on landfills in the province was obtained from *Waste Management Master Plans*, the MOE *Site Summary Reports*, the MOE *Inventory of Open and Operating*

Landfills, and a survey of 420 landfills carried out by VHB and MacLaren Engineers (1991) as part of a concurrent study.

Information on the three MSW incinerators in operation in Ontario was obtained through telephone conversations with the operators. Information on transfer stations was obtained in *Waste Management Master Plans*, and was confirmed by follow-up phone calls.

Information on waste haulers was obtained through an industry survey carried out by Dun and Bradstreet as part of this study. Information on the hauling and recyclers was purchased from Dun and Bradstreet.

Information on recycling programs, expenditure on recycling, and the quantities of material recycled was obtained from the MOE Waste Management Branch, OMMRI and the COBIS Report. Information on material recovery facilities (MRF) was obtained through a survey carried out by VHB and MacLaren Engineers (1991).

2.1.3 Summary of findings

The results of the study of the physical and economic dimensions of municipal solid waste management in Ontario can be placed into three groupings: waste generation; waste disposal and waste recycling.

Waste generation

The estimates of residential and IC&I sectors waste generation developed by CH2M Hill and Maclaren Engineers (1991) and used as the base case (current trend) in this study are summarized in Table 5 and Table 6.

- The Ontario residential sector generated 3,901,900 tonnes of waste in 1987 and 4,053,200 tonnes of waste in 1989 (approximately 420 kg/capita/year for both years). The major waste types of residential waste are newsprint (16.7 per cent), food waste (15.5 per cent) and yard waste (16.2 per cent). An estimated 2.5 per cent of the residential waste stream was recycled in 1987. This increased to 5.1 per cent in 1989.

- The IC&I sector generated 5,189,000 tonnes of waste in 1987 and 5,361,000 tonnes of waste in 1989 (approximately 560 kg/capita/ year in 1987 and 559 kg/capita/year in 1989). The major waste types generated by the IC&I sector include: old corrugated cardboard (OCC), wood, paper, organics and metal. The major generators of MSW in the IC&I sector include the construction industry (1.6 million tonnes of waste in 1989), the communications and service sector (1.3 million tonnes of waste in 1989), wholesale and retail trade (550,000 tonnes of waste in 1989), transportation

Table 5
Estimated waste generation in the residential sector

Component		1987		1989	
		Quantity (tonnes)	Per cent composition	Quantity (tonnes)	Per cent composition
Paper					
Newspaper		650,200	16.66%	673,200	16.61%
Fine Paper		71,500	1.83	74,000	1.83
Boxboard		167,200	4.29	173,100	4.27
Old corrugated cardboard (OCC)		105,200	2.70	108,900	2.69
Magazines		159,500	4.09	165,100	4.07
Mixed paper (waxed/plastic/mixed)		57,300	1.47	59,300	1.46
Phone books		12,600	0.32	13,000	0.32
Composite packaging		11,000	0.28	11,400	0.28
Other (kraft/wallpaper/tissue)		189,300	4.85	196,000	4.84
	Subtotal	1,423,800	36.49	1,474,000	36.37
Glass					
Food/beverage containers		259,300	6.65	268,500	6.62
Other		21,900	0.56	22,700	0.56
	Subtotal	281,200	7.21	291,200	7.18
Steel					
Food/beverage containers		72,500	1.86	75,100	1.85
White goods		97,900	2.51	101,400	2.50
Other		54,400	1.39	56,300	1.39
	Subtotal	224,800	5.76	232,800	5.74
Aluminum					
Beverage containers		0	0.00	13,500	0.33
Other containers		10,000	0.26	10,400	0.26
Foil (rigid/flexible)		2,800	0.07	2,900	0.07
Other		4,200	0.11	4,300	0.11
	Subtotal	17,000	0.44	31,100	0.77
Plastic					
PET bottles		3,700	0.09	3,800	0.09
HDPE bottles		11,100	0.28	11,500	0.28
Other rigid		108,100	2.77	111,900	2.76
Film		120,700	3.09	125,000	3.08
	Subtotal	243,600	6.24	252,200	6.22

Source: CH2M Hill 1991.

Table 5
Estimated waste generation in the residential sector (continued)

Component		1987		1989	
		Quantity (tonnes)	Per cent composition	Quantity (tonnes)	Per cent composition
Organics					
Food waste		603,300	15.46	624,600	15.41
Yard waste (leaves/grass/weeds)		472,800	12.12	489,500	12.08
Yard waste (brush)		159,300	4.08	164,900	4.07
	Subtotal	1,235,400	31.66	1,279,000	31.56
Wood waste		45,100	1.16	46,700	1.15
Construction and demolition waste					
Drywall		11,100	0.28	11,500	0.28
Other		50,300	1.29	52,100	1.29
	Subtotal	61,400	1.57	63,600	1.57
Diapers		107,200	2.75	111,000	2.74
Used tires		800	0.02	800	0.02
HHW		22,600	0.58	23,400	0.58
Other		239,000	6.13	247,400	6.10
Total		3,901,900	100.00	4,053,200	100.00
Population		9,271,500		9,598,600	
Generation rate (Kg/person/year)		421		422	

Source: CH2M Hill 1991.

Table 6
Estimated waste generation in the IC&I sector

Component	1987		1989	
	Quantity (tonnes)	Per cent composition	Quantity (tonnes)	Per cent composition
Old corrugated cardboard	450,000	8.67	441,000	8.23
Office paper	345,000	6.65	354,000	6.60
Other paper	424,000	8.17	426,000	7.95
Total Paper	1,219,000	23.49	1,221,000	22.78
Glass	279,000	5.38	282,000	5.26
Metals	558,000	10.75	599,000	11.17
Plastics	167,000	3.22	163,000	3.04
Organics	568,000	10.95	600,000	11.19
Wood waste	1,114,000	21.47	1,130,000	21.08
Used tires	82,000	1.58	88,000	1.64
Other	1,202,000	23.16	1,278,000	23.84
Total	5,189,000	100.00	5,361,000	100.00
Population	9,271,500		9,598,600	
Generation rate (Kg/person/year)	560		559	

Source: CH2M Hill 1991.

industries (380,000 tonnes of waste in 1989) and the food and beverage industry (340 000 tonnes of waste in 1989).

- Traditionally, comprehensive records of waste disposal at landfills and incinerators have not been maintained, hence reliable waste generation information is not available for many locations in the province. In the past, very little information was collected on the composition of MSW. This has changed in the last year or two, with the landfill crisis in Southern Ontario, and the need to divert more materials from landfill. Many Ontario municipalities are now embarking on waste audits and waste composition studies to better define the components of the waste stream.

Waste disposal

The following summarizes the physical and economic dimensions of waste disposal in Ontario.

- Landfill is the method of disposal for most of Ontario's MSW. Less than two per cent of Ontario's MSW is incinerated (Ontario has three incinerators which accept MSW). Ontario has over 1,400 landfills. Of these, 630 (45 per cent) serve communities with populations less than 1,500, and another 350 (25 per cent) are operated by the Ministry of Natural Resources.

- One per cent of Ontario's MSW was recycled through residential recycling programs in 1987 and two per cent in 1989. At least a further three per cent of the total waste stream is recycled by the Ontario IC&I sector.

- Forty per cent of Ontario's annual landfill capacity will be lost in the next 1 - 3 years. Approximately 17 per cent of Ontario's landfill capacity will be lost in 1991 with the projected closure of two of the province's largest landfills, Britannia Road (750,000 tonnes/year) and Brock West (964,000 tonnes/year). An additional 23 per cent of Ontario's landfill capacity will be lost in 1993, with the projected closure of the Province's largest landfill, Keele Valley (2,250,000 tonnes/year).[6] Of the province's remaining landfills, an additional 95 are expected to reach capacity in 1991-1993. An estimated 145 will reach capacity between 1994 and 2003, and 10 will extend beyond the year 2004.

- Landfill tipping fees vary through the province, from zero at some landfills to $150 per tonne in the Metropolitan Toronto area. In some cases, tipping fees have increased dramatically in the last few years. Metro Toronto area tipping fees per tonne of waste have increased as follows: $18 (1987), $50 (1988), $85 (1989), $97 (1990), and $150 (1991). Increased tipping fees have encouraged 3R's, which can now be justified on an economic basis. Smaller communities are reluctant to raise tipping fees, because of a concern about illegal dumping of waste.

- Sixty-five hauling companies were surveyed as part of this study, and reported employment of 792. An additional 145 haulage companies who were not surveyed employ an estimated 1,977. However, some of these firms may be involved in other activities in addition to hauling. Total reported sales for haulers (both surveyed, and not surveyed) were $103 million. If it is assumed that large companies generally report sales figures, then this value should capture most of the haulage industry. The majority of respondents to the study survey anticipate a favourable business climate in the future.

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[6] These three landfills did not close in 1991.

Waste recycling

The following summarizes the physical and economic dimensions of waste recycling in Ontario (CH2M Hill and Maclaren Engineers 1991).

- Residential waste recycling programs have increased dramatically in the last few years. In 1987, 400,000 households were served by the Blue Box Program. This number increased to 1.8 million households by 1989. A total of 97,000 tonnes of waste generated by the residential sector were recycled in 1987 (2.5 per cent of the residential waste stream) and 206,400 tonnes were recycled in 1989 (5.1 per cent of the residential waste stream).

- Complete data are not available on the percentage of MSW recycled by the IC&I sector. RIS (1991) found that at least 279,760 tonnes of waste was recycled by the IC&I sector in 1989 (5.2 per cent of the IC&I waste stream).

- Municipalities spent $10 million on residential waste recycling in 1987, $30 million in 1988 and $42.5 million in 1989. The average operating cost of recycling residential waste in 1989 was $124.83 per tonne.

- The prices paid for recycled material have varied over the last three years and, with the exception of aluminum, have generally decreased. The 1990 price for old newspaper was $7 - 12 per tonne. This price was low because of a labour dispute at the only Ontario de-inking mill. Prices for other recycled materials were $60 per tonne for sorted glass, $70 per tonne for loose steel, $90 per tonne for densified steel, $1,400 - 2,000 per tonne for baled aluminum, $300 per tonne for baled PET, and $125 per tonne for unbaled PET. Aluminum is clearly the most valuable material collected by the Blue Box Program but accounts for less than 0.5 per cent of the residential waste stream.

- In 1987, 88 municipalities were served by 98 active recycling programs. There were 52 active recyclers employing 287 full- or part-time staff (10 of whom were physically or mentally challenged) and 207 volunteer workers.

- The Ontario recycling industry employs 3 400 people. Annual sales volumes are reported at $590 million. Approximately 30 per cent of these companies started operations in the 1980-1989 period. In general, most of the companies surveyed as part of this study expected an increase in business resulting from recycling initiatives.

- There are 31 MRF in the province, mostly located in Southern Ontario. These facilities are operated by either the municipality, the private sector or the third party sector (not-for-profit organizations). Fourteen of these employ 308 full-time and 17 part-time staff.

- Anticipated trends in 3R's include a greater focus on composting organic wastes. Organics account for 32 per cent of the residential waste stream. Composting is currently encouraged by offering individual composters to households, or by curbside collection of kitchen and yard wastes for processing at a centralized composting facility.

- Bans on accepting materials such as drywall, OCC, wood wastes, white goods, etc. at landfills are expected to stimulate increased 3R's of these waste streams.

- Substantial opportunities exist for municipalities to expand the Blue Box Program beyond the traditional four materials (newspaper, glass, metal and PET) to include corrugated cardboard, phone books and household hazardous waste. Other municipalities are experimenting with including film plastic, boxboard, magazines and fine paper in their programs.

2.2 Market assessment of 3R's activities in Ontario[7]

2.2.1 Study objectives

Resource Integration Systems Ltd. (RIS) and VHB Research and Consulting Inc., were hired by the Ontario Ministry of the Environment to conduct a market assessment of 3R's activities in Ontario. The primary objective of the study was to determine what municipal solid waste types are amenable to each of the 3R's - source reduction, reuse and recycling. A second objective of the study was to provide an assessment of the markets for recyclable materials, particularly in terms of the current use of secondary materials and the potential use of these materials.

The report provides:

- 1989, 1992 and 2000 generation and diversion levels (3R's) for waste types in the residential and IC&I sectors;

- quantities of these materials that could be diverted from landfill and incineration for the years 1992 and 2000 given market conditions in 1990;

- an overview of markets for recyclable materials; and

- an indication of possible options for increasing the diversion rates of recyclable materials to assist the government in meeting the 25 per cent and 50 per cent waste diversion targets.

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[7] This section is adapted from RIS and VHB, 1991.

While the main focus of the study was on markets for secondary material recovered from the MSW stream, reduction and reuse opportunities were also noted where appropriate. The results of this study were also used to define a base case (current trend) of waste generation and diversion for the years 1987, 1989, 1992 and 2000 against which the efficiency and effectiveness of the measures and scenarios developed in this study, to achieve the provincial diversion targets could be assessed. The base case (current trend) assumes no new policy initiatives after December 31, 1990.

For the purpose of this study, MSW was defined as total post-consumer waste from residential and IC&I sources exclusive of the following:

- hazardous and liquid industrial waste as defined by Ontario's Regulation 309 under the Environmental Protection Act;
- household hazardous waste;
- municipal sewage sludge; and
- industrial scrap metal.

Current and projected waste generation and diversion, potential for 3R's activities, secondary materials market structure (including factors that influence demand and supply, secondary materials' price elasticities) and the ability of the market to absorb the projected supply of the secondary material was provided for 17 waste types:

- old newspapers;
- fine paper;
- mixed paper;
- boxboard;
- old corrugated cardboard;
- magazines;
- telephone books;
- plastics;
- glass containers;
- tinplate steel cans;
- aluminum;
- organics;
- disposable diapers;
- wood waste;
- drywall;
- scarp tires; and
- foundry sand.

2.2.2 Methodology and data sources

RIS estimated the potential waste generation and diversion rates for 1992 and 2000 based on information on the composition of the MSW streams and on current recovery levels. Precise quantities and composition of materials in the MSW stream in Ontario are not well documented and therefore estimates were necessary. RIS (1991) relied upon the following sources of information:

- Ontario residential waste composition as documented in CH2M Hill Engineering Ltd and MacLaren Engineers (1991); and

- Industrial/commercial/institutional waste composition information obtained from industry sources. In many instances, the IC&I sector estimates were derived by netting the residential waste generation estimates by CH2M Hill from the total consumption of products/materials as provided from industry.

Differences emerged between CH2M Hill and MacLaren Engineers (1991) estimates of IC&I wastes (based on waste stream composition data gathered from various sources (Gore and Storrie 1990; Seattle 1989; Franklin and Associates 1987; Bird and Hale 1978; Metro Toronto 1984) and sectoral employment data for Ontario, and RIS's IC&I waste generation estimates (based on information obtained directly from industry sources on production and shipments and waste audits and surveys). RIS (1991) reconciled these differences through selecting the most reliable IC&I waste generation data by waste type between its survey of industry and CH2M Hill's and MacLaren Engineers' (1991) study. In general, RIS (1991) used waste generation information gathered from its survey of industry. A comparison of these alternative estimates and the rationale for the selection of appropriate estimates for use in the present study is provided.

Based on residential waste composition figures provided by CH2M Hill and MacLaren Engineers (1991) for 1989 and the RIS (1991) IC&I waste composition estimates, diversion levels were estimated for the years 1992 and 2000. These estimates were based on information about policies in place as of 1989, (such as the blue box program and the National Packaging Protocol) and through discussions with industry. RIS (1991) assumed that no new policy initiatives would be introduced after December 31, 1990 for the assessment of the expected diversion rates for various materials in 1992 and 2000. This assumption still allowed for the full effect of programs already in place at that time to take effect in 1991 and beyond.

RIS (1991) projected residential material recovery through blue box programs, based on the number of households with blue boxes increasing from the 1989 year end level of just over 2 million to 2.9 million in 1992 and 3.5 million in 2000. The number of blue boxes in place is expected to increase by 13 per cent per annum from 1989 to 1992 and by 2 per cent per annum from 1992 to 2000. The projected material generation and recovery for both the residential and IC&I sectors is based on a provincial population of 10,022,000 in

1992 and 10,896,000 in 2000 (population growth of one per cent per annum). The residential per capita waste generation is assumed to be 422 kg (CH2M Hill and MacLaren Engineers 1991) for 1992 and 2000. The IC&I per capita waste generation is assumed to be 550 kg per capita for 1992 and 2000.

RIS (1991) also gathered data on secondary materials markets in Ontario, Quebec, and adjacent U.S. states based on reviews of the literature, and industry and government sources. In addition, information on prices and quantities was obtained on markets for selected materials for which little market history exists. For each market category, the following information was compiled, to the extent possible:

- number and location of firms;
- current and planned capacity;
- market price ranges; and
- quality specifications.

Where possible, these data were used to estimate demand, supply, and cross price elasticities for selected recyclable materials. As well, estimates of elasticities from published studies were identified through a computerized literature search. Key stakeholders for each secondary material from both demand and supply sides of the market were also interviewed in an attempt to derive estimates of price elasticities for 1992 and 2000.

2.2.3 Summary of findings

Four main findings emerged from this study relating to i) the likelihood of existing 3R's programs (at the end of 1990) achieving the government's waste diversion targets, ii) the long standing existence of secondary materials markets, iii) specific areas where substantial increases in diversion will be required to meet the targets and iv) various opportunities for government initiatives to stimulate secondary materials markets.

1. **Current waste generation and diversion practises are unlikely to meet the stated targets without new policy initiatives from the Ontario Minister of the Environment and municipalities.**

   In 1989, 9.8 million tonnes of MSW were generated in Ontario from both the residential and IC&I sectors, excluding hazardous waste, sewage sludge and scrap metal.

The assessment of 3R's activities in place and projected, as of December 31, 1990 are not likely to divert sufficient quantities of waste to meet Ontario's waste diversion targets of 25 per cent by 1992 and 50 per cent by 2000. Based on the available data, a total diversion of 15 per cent will be achieved by 1992, and 27 per cent by 2000.

2. **Markets for secondary materials have existed for a long time.**

Markets for many secondary materials are not new. For example, markets for post-industrial paper fibre and steel have existed for many years and there is an established infrastructure of brokers and buyers as well as end users for these materials. What is new is the collection of post-consumer (residential, commercial, institutional, retail) secondary materials through municipal recycling programs. This increase in the supply of secondary materials has resulted in large fluctuations in the price of these secondary materials.

For some waste types, such as boxboard (used for cereal and detergent boxes), telephone books, and disposable diapers, limited or no secondary markets exist. However, the pressure to take full responsibility for the wastes associated with a particular product, often referred to as product stewardship, is leading producers to assist in the development of 3R's activities and markets to absorb and reprocess these materials.

3. **There are waste types where diversion is limited and substantial increases in their waste reduction and recycling will be required to meet the government's waste diversion targets.**

The following waste types provide the largest opportunities for increased waste diversion.

Waste type	Municipal solid waste sector
• Fine paper	Residential and IC&I sectors
• Magazines	Residential and IC&I sectors
• Boxboard	IC&I sector
• Glass containers	Residential and IC&I sectors
• Plastic (film)	Residential and IC&I sectors
• Organic food waste	Residential and IC&I sectors
• Organic yard waste	Residential sector
• Wood waste	IC&I sector

In developing initiatives to stimulate current and create new markets for secondary materials, the structure and operation of existing markets should be recognized.

4. **The government could undertake market development initiatives to stimulate the secondary materials markets.**

Specific initiatives designed to assist in increasing the volume of recyclable materials collected and to accommodate these materials in the market place could be implemented by the government. Initiatives for improving the collection and sorting of all waste types would also improve the structure of the secondary materials markets. There is a need for reprocessing capacity, to divert them from waste disposal.

The provincial government's role in stimulating secondary materials markets may include:

- providing market information to suppliers and users of secondary materials;
- providing financial incentives to industry to assist in the development of viable end-use markets;
- monitoring Ontario market development activities to ensure that Ontario supplies of post-consumer secondary material are given preference;
- developing clear and equitable regulations for packaging and short term consumer goods waste diversion, including targets for source reduction reuse and recycling;
- instituting provincial government procurement guidelines favouring products made from post-consumer secondary materials, and encouraging other levels of government to do the same; and
- funding and encouraging research and development for innovative recycling technologies and means by which 3R's activities may be enhanced.

2.3 True costs of municipal waste management[8]

2.3.1 Objectives and scope

The objective of this report was to review the costs of waste management in Ontario to determine if the true costs of waste management are accounted for in the setting of tipping fees, how they might be expected to change over time, and the use and potential for mechanisms that ensure that generators pay for these costs in proportion to their demands for waste management services (i.e. the polluter pays principle).

The true costs of waste management are all the costs associated with providing waste management services. The true costs include the internal, private costs faced by the owner or operator of a waste management facility, the external costs of regulatory agencies and the social and environmental costs associated with the waste management service.

The report provides the following information:

- Costs incurred by Ontario waste management facilities in 1989, based on a mail survey;
- Replacement costs of waste management facilities based on computer models and the published literature;
- A review of revenue generation mechanisms, based on the published literature and case studies from other jurisdictions;
- An assessment of the revenue generated by Ontario waste management facilities, based on a mail survey; and
- An assessment of how costs and revenues can be balanced.

2.3.2 Methodology and data sources

Several approaches were pursued to gain the information reported in this report. Information on existing costs of waste management were collected through a mail survey of Ontario facility owners or operators and a review of the Ministry of Municipal Affairs' MARS database. The survey involved the mailing of 569 questionnaires to waste management facilities of which 218 were returned. A total of 58, or 35 per cent of questionnaires sent to large landfill operators (receiving more than 5,000 tonnes of waste per annum) were returned. For small landfill facilities (receiving less than 5,000 tonnes of waste per annum), 146 questionnaires were returned, or 39 per cent of the survey questionnaires mailed to small landfill facilities. A total of 14 out of 32 recycling facilities

[8] This section is adapted from VHB and MacLaren Engineers, 1991.

responded (43 per cent). The three incinerators in Ontario receiving municipal solid waste were contacted by telephone.

Replacement cost estimates are presented based on standard engineering design models. Experience with revenue generation mechanisms and reserve funds is based on a literature review, and interviews with jurisdictions operating relevant programs.

Status of the data

It is estimated that the survey returns cover waste management facilities accounting for 66 per cent of the waste generated in Ontario. However, many facility operators were unable to answer all questions about costs, revenues and their components. Responses show a wide variation and great care must be taken in the use of the data.

2.3.3 Summary of findings

The results of the study of the true costs of municipal waste management in Ontario included evaluation of the following social costs:

- internal costs of waste management;
- external social costs of waste management;
- waste management revenue generating mechanisms;
- costs of waste management; and
- waste management costs and revenue balancing mechanisms.

Internal costs

The cost of landfill varies by both the amount of waste a facility receives and, to a lesser extent, by the age of the facility. The unit cost of waste received varied between an average of $12 per tonne for landfill facilities accepting more than 5,000 tonnes of waste per annum to an average of $31 per tonne for facilities accepting 5,000 tonnes or less of waste per annum. For both large and small landfill facilities the unit cost was less for facilities greater than twenty years of age than those facilities less than twenty years old.

The annualized capital cost for incineration is $47 per tonne. Operating costs were not provided by the facilities surveyed.

The cost of processing secondary material varies between $580 per tonne for facilities processing 10,000 or less tonnes of secondary materials per annum and $181 per tonne for facilities processing over 20,000 tonnes of secondary materials per annum. It appears that there is a considerable reduction in the unit cost of processing secondary materials as the size of the processing facility increases.

The average cost of collecting waste for disposal is $34 per tonne. For municipalities generating less waste the cost is slightly lower resulting from lower transportation costs. The simple average cost of collecting recyclable materials is $100 per tonne. Municipalities with lower population densities, such as those in northern Ontario, have higher collection costs of recyclable materials.

External costs

The external social costs of landfill are difficult to assess. Land value impacts indicate that the loss in market value for properties adjacent to landfill facilities accounts for less than six per cent of the total costs of landfill. However, these cost impacts do not include property owner's welfare losses. "Waste surcharges" adopted by municipalities also may not fully account for welfare losses incurred by affected citizens.

Landfills also result in certain environmental impacts for which there may be costs associated with these impacts, their amelioration or their avoidance. The cost of actions taken by landfill operators to address potential environmental impacts is minimal with most environmental concerns addressed through the changing of the landfill facilities daily management or operation.

The major external cost of incinerators is the potential impacts on human health and ecosystem health, primarily but not exclusively as a result of atmospheric emissions.

No assessment has been undertaken to assess the external costs from material processing facilities or from waste collection.

Little data are available on the public sector costs of waste management. Data were collected for landfill facilities only. The greatest cost incurred by the provincial public sector is during the approval and review process for new landfill sites.

Revenue generating mechanisms

The major source of revenue for waste management facilities in the province is general municipal revenues. Recycling facilities receive most of their revenues from the sale of recyclable materials and provincial grants. The revenues through the sale of recyclable materials varies according to the type of material and the demand for the material in the secondary materials market. At present the average revenues from the sale of recyclable materials, $78 per tonne, do not cover the average cost per tonne of collecting and

processing recycled materials ($181 per tonne). This will be an on-going problem until markets for recyclable materials are fully developed.

Tipping fees are also a source of revenue for large landfill facilities in the province. Of the 13 large landfill facilities that responded in a telephone survey 11 indicated that 50 per cent or more of the waste they received is subject to a tipping fee. Typically, it is waste received from industrial and commercial sources which are charged a tipping fee.

Provincial grants are provided through a number of programs designed to assist municipalities finance waste management facilities. The programs include: Municipal Recycling Support Program (MSRP) which assists municipalities in establishing curbside recycling programs; the MSRP also provides funding for northern communities establishing and operating recycling programs; the Municipal Recovery Program which provides capital grants to municipalities for waste processing facilities; the Municipal Reduction/Reuse Program to encourage greater awareness of buying and using products which can reduce waste generation; and the Financial Assistance Program, which assists municipalities develop new landfill sites, transfer stations and processing facilities.

Costs of waste management

Much of the cost of waste disposal is paid for out of general municipal revenues, supplemented by provincial grants to assist in the approvals processes, and in the start–up of some types of waste management facilities. This is particularly noticeable in the case of the small landfills. Even where there are tipping fees they are rarely applied to most of the waste dumped. For example, waste dumped by local municipal collectors are not subject to the tipping fee.

Most waste management facility operators set their tipping fees without regard for the specific waste management costs they incur. Even where costs are considered, it is unusual that all costs are considered. While 93 per cent of those who consider costs in setting their tipping fees consider operating costs, only about half consider such expenses as post–closure costs, replacement costs, insurance and environmental contingencies.

A breakdown showing the comparison for different levels of tipping fees or revenues (in the case of recycling facilities) and costs is presented in Table 7. The results are for facilities which provided both cost and revenue data. The cost per tonne for large landfill facilities is $12 per tonne or 18 per cent of the weighted average tipping fee collected, $67 per tonne. Typically, the tipping fee applies to only IC&I and privately hauled wastes. The cost for small landfills is more, $31 per tonne. No tipping fee revenue data is available from the approximately one-quarter of small landfill facilities which charge a tipping fee.

The annualized cost per tonne for incinerators is $47 per tonne and revenues, through the sale of energy, amount to about $50 per tonne of waste. The cost of recycling facilities is

Table 7
Comparison of costs and revenues

Type of facility	Costs[a] (1989$/t)	Revenues[b] (1989$/t)	Net Cost (1989$/t)	Ratio of costs to revenues
Large landfills	$12.24	$66.80	($54.46)	0.18
Small landfills	$30.83	No data[c]	Insufficient data	Insufficient data
3R's facilities	$159.00	$78.00	$81.00	2.04
Incinerators	$47.28[d]	$49.81	($2.53)	0.95
Total waste management costs	$45.00[e]	Insufficient data	Insufficient data	Insufficient data

Source: VHB and MacLaren Engineers 1991.

Notes:
a Weighted average total annualized collection and landfill/processing cost per tonne for each type of facility.
b Weighted average tipping fee or revenue per tonne (recycling facilities only).
c Approximately three–quarters of all small landfills have no tipping fee.
d Annualized capital cost per tonne.
e Average cost of waste management collection and disposal.

$159 per tonne while the revenue, through the sale of recyclable materials is $78 per tonne. On average, costs to handle and process a tonne of recyclable material are two times the revenue received from the sale of these materials. To improve the cost effectiveness of recycling facilities the cost per tonne will have to decrease or the revenues per tonne increase.

Total waste management costs (collection and disposal) average about $45 per tonne.

The average costs and revenues from recycling facilities are also presented in Table 7. The average gross cost for recycling facilities in the Province, including collection, is $159 per tonne. The simple average costs of collecting recyclable materials is $100 per tonne. Revenues per tonne average $78. The net cost per tonne of waste diverted for recycling is $81 per tonne.

Cost and revenue balancing mechanisms

An objective of the Ministry of the Environment is to have waste management services priced according to “true” cost accounting. The imposition of economic charges that cover the cost of waste management will also affect the type of waste management system used by waste generators. The application of the principles of “true” cost accounting to waste management revenue generating mechanisms requires the “internalizing” of costs associated with waste management that previously were paid from other revenue generating sources.

A number of revenue generating mechanisms exist which can be implemented to ensure waste management services are priced according to “true” cost accounting principles such as:

- reserves and reserve funds
- tipping fees
- user charges
- product disposal taxes and deposit charges

Reserves and reserve funds are a financial mechanism which provides a means for generators to finance the post closure and replacement costs or other specific costs associated with the operation of a waste management facility. The advantage of a reserve fund is that revenues are collected to cover future costs resulting from the current use of waste management facilities. Future waste generators are then not burdened with costs resulting from current use and current users are paying a cost which more accurately reflects their use of the facility.

Tipping fees are charges applied on a unit basis to waste received at a waste management facility. Tipping fees should include all internal and external social costs of waste management. Although a tipping fee can be set to account for all waste management costs over the life of a facility, the level at which the tipping fee should be applied over time is difficult to assess. If the tipping fee is set too low, high initial rates of waste disposal from generators will result and the capacity of the landfill facility will decrease quickly. In future years the tipping fee will be set at higher rates to discourage disposal. The result may be future generators paying an unfair portion of the total waste management costs and the loss of landfill capacity filled with types of waste that could be diverted elsewhere.

Surcharges can be added to tipping fees to cover the costs of other waste management activities such as recycling programs. Tipping fees may also take the form of differential fees where wastes that take up less volume, degrade more easily or are less toxic are charged a lower tipping fee.

User charges are fees imposed directly on the waste generator. Typically, user charges have taken the form of a pay-by-the-bag or variable-rate system. The advantage of user charges is that each generator pays for the amount of waste generated and that user charges are an incentive for generators to produce less waste. However, user charges result in increased administrative costs and inequities since lower income groups may be impacted unfairly by paying a larger portion of their income for waste management services while generating the same or less waste than higher income groups.

Product disposal taxes and deposit charges are fees applied directly to products and cover the cost of disposal. The cost of disposal is internalised into the price of the product. The imposition of product disposal taxes or deposit charges results in a reduction in the amount of waste going to disposal. The administrative cost of such measures can be high and product disposal taxes provide no direct incentive to recycle waste materials.

2.4 Summary

Four studies were undertaken for the Ontario Ministry of the Environment. The first three of these studies provided information for Ontario on the physical and economic dimensions of municipal solid waste management, the market for 3R's activities and the true costs of municipal waste management.

The following summarizes the conclusions regarding the physical and economic dimensions of municipal solid waste management in Ontario (CH2M Hill and MacLaren Engineers 1991).

- Traditionally, comprehensive records of waste disposal at landfills and incinerators have not been maintained, hence reliable waste generation information is not available for many locations in the province. In the past, very little information was collected on the composition of MSW. This has changed in the last year or two, with the landfill crisis in Southern Ontario, and the need to divert more materials from landfill. Many Ontario municipalities are now embarking on waste audits and waste composition studies to better define the components of the waste stream.

- Landfill is the method of disposal for most of Ontario's MSW. Less than two per cent of Ontario's MSW is incinerated. Residential waste recycling programs have increased dramatically in the last few years. One per cent of Ontario's MSW was recycled through residential recycling programs in 1987 and two per cent in 1989. At least a further three per cent of the total waste stream is recycled by the Ontario IC&I sector.

- Increased tipping fees have encouraged 3R's, which can now be justified on an economic basis. Smaller communities are reluctant to raise tipping fees, because of a

concern about illegal dumping of waste. Bans on accepting materials such as drywall, OCC, wood wastes, white goods, etc. at landfills are expected to stimulate increased 3R's of these waste streams.

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- Significant opportunities exist for municipalities to expand the Blue Box Program beyond the traditional four materials (newspaper, glass, metal and PET) to include corrugated cardboard, phone books and household hazardous waste in their programs. Other municipalities are experimenting with including film plastic, boxboard, magazines and fine paper in their programs.

- Complete data are not available on the percentage of MSW recycled by the IC&I sector. Anticipated trends in 3R's include a greater focus on composting organic wastes. More research should be carried out in this area.

- In general, most of the companies surveyed (waste haulers, recyclers, MRF) expect an increase in business resulting from recycling initiatives.

The following summarizes the conclusions and recommendations regarding the assessment of the secondary materials market in Ontario (RIS and VHB 1991).

- Current waste generation and diversion practises in place and projected, as of December 31, 1990 are unlikely to divert sufficient quantities of waste to meet Ontario's waste diversion targets of 25 per cent by 1992 and 50 per cent by 2000 (The effect of new initiatives announced by the Minister of the Environment in February, 1991, and other possible policy options are analyzed in this report).

- Markets for many secondary materials are not new. For example, markets for post-industrial paper fibre and steel have existed for many years and there is an established infrastructure of brokers and buyers as well as end users for these materials. What is new is the collection of post-consumer (residential, commercial,

institutional, retail) secondary materials through municipal recycling programs. This increase in the supply of secondary materials has resulted in large fluctuations in the price of these secondary materials.

- The following waste types provide the largest opportunities for increased waste diversion: fine paper; magazines; IC&I boxboard; glass containers; plastic (film); residential food and yard wastes; and industrial wood wastes.

- For some waste types, such as boxboard (used for cereal and detergent boxes), telephone books, disposable diapers, etc., limited or no secondary markets exist. However, the pressure to take full responsibility for the wastes associated with a particular product, often referred to as product stewardship, is leading producers to assist in the development of 3R's activities and markets to absorb and reprocess these materials. In developing initiatives to stimulate current and create new markets for secondary materials, the structure and operation of existing markets will play an important role.

- Specific initiatives designed to assist in increasing the volume of recyclable materials collected and to accommodate these materials in the market place could be implemented by the government and may include: monitoring and providing market information and financial support to suppliers and end-users of secondary materials; developing clear and equitable regulations for waste diversion; and instituting provincial government procurement guidelines favouring products made from post-consumer secondary materials.

The following summarizes the conclusions and recommendations regarding the true costs of waste management in Ontario (VHB and MacLaren Engineers 1991).

- Most facilities have very little information about costs and revenues for waste management. Monitoring of waste inputs, costs and revenues should be part of waste management facility monitoring requirements.

- Although there are wide variations from facility to facility, the total waste management costs for landfills are $46 per tonne. This includes $12 per tonne for waste disposal and $34 per tonne for waste collection. The total cost for incinerators is $81 per tonne, including $34 per tonne for waste collection. The per tonne unit cost for recycling facilities is $181. The average revenue per tonne of recyclable materials collected is $78 per tonne. New landfills will be more expensive: typical costs are likely to be $40 per tonne. Costs at very small facilities will be even higher.

- External social costs of landfills and incinerators are not well understood, but appear to be quite minor (i.e. less than 10 per cent of replacement costs). External costs and

benefits of recycling are largely unknown. An assessment of the social costs and benefits of recycling should be undertaken to assist in determining priorities for public funds.

- A surcharge should be placed on tipping fees to cover (some) external social costs, and to provide funds for closure and post–closure care. Tipping fees should be raised at landfills where these fees are lower than the cost of managing the waste. Facility management costs should include all management aspects.

- Ontario facilities rely primarily upon general revenues and tipping fees to finance waste management facilities. At the largest facilities, tipping fees are well in excess of costs; at most small facilities, tipping fees (where they exist at all) are below the average cost per tonne of waste managed. Other revenue generation mechanisms have been introduced in other jurisdictions and may help Ontario meet its goals of diverting waste from disposal and making the waste management system "financially sustainable". Some of these—like deposit charges—are effective but expensive. The effectiveness of others—like pay–by–the–bag systems—has not been well documented. New revenue generation mechanisms should be tested, with analysis of pilot implementations to assess effectiveness and impacts.

2.4.1 Reconciliation of IC&I Estimates

Differences emerged between CH2M Hill and MacLaren Engineers' (1991) and RIS's (1991) IC&I waste generation estimates.

In the CH2M Hill and MacLaren Engineers' (1991) study, per employee waste generation rates (derived from: Gore and Storrie 1990; Seattle 1989; Franklin and Associates 1987; Bird and Hale 1978; Metro Toronto 1984) were developed for each Input Matrix Category (IMC - as defined by ERL) and multiplied by employment in each IMC to estimate total IC&I generation. However, CH2M Hill and MacLaren Engineers found it difficult to provide a detailed breakdown of waste generation by waste type for the IC&I sector since few data regarding IC&I generation by waste type were available for a number of IMCs. Where waste generation estimates for specific IC&I waste types were unavailable, the waste types were put into the "Other" waste category. For some waste types, the method provided no estimates of waste generation, and CH2M Hill and MacLaren Engineers incorporated RIS's IC&I waste generation estimates into their own.

RIS (1991) used a "total wastes by commodity" approach to derive their estimates of IC&I waste generation. IC&I waste composition was derived by contacting industry sources. In instances where industries were unable to provide waste generation rates for specific materials IC&I estimates were derived by netting the residential waste generation from the total consumption of that material. For example, the tonnes of old newspapers generated in the IC&I sector was estimated as the difference between the number of

tonnes of newspapers produced and generation of old newspapers in the residential sector. Total consumption of materials was provided by industry sources.

These two methods were reconciled by RIS through consultation with stakeholders associated with each waste type, resulting in an estimate of about 5,361,000 tonnes of IC&I waste generated in Ontario in 1989. The present study uses this estimate of total IC&I waste generation since it provides the level of disaggregation by waste type required for scenario modelling.

3 Policy scenarios

In this study a policy measure is defined as a single initiative undertaken by government to achieve an objective. Such initiatives can take the form of a regulation (e.g. banning specified types of wastes from landfill) or an economic instrument (e.g. imposing a tipping fees surcharge on specified wastes to discourage their disposal at landfills.) Information dissemination or the creation of educational materials for schools are also examples of policy measures.

A policy program comprises a set of policy measures. It is unlikely that any single measure will be effective enough to meet the government's waste diversion targets and so consideration must be given to a program of measures. Several such programs, referred to as scenarios, were developed in this study and their effects analyzed using the two models referred to in section 1.5. This chapter enumerates the individual measures that were considered as candidates for inclusion in the scenarios. It also describes the scenarios and reviews the evaluation criteria used in their assessment.

3.1 Policy measures

A total of 18 policy measures were considered. These are:

- Deposit systems
- Increase municipal funding for 3R's
- Landfill tipping fees
- Packaging taxes

- Subsides to producers
- Subsidized home composters
- User charges
- Virgin materials taxes
- Changing product specifications
- Education programs
- Expanded *Blue Box* system
- Industrial waste audit
- Landfill bans
- Mandatory processing of solid waste
- Mandatory source separation
- Product bans
- Recycled content regulation
- Yard and organic waste collection

A detailed account of each of these measures is given in Appendix A which includes a description of each measure, a review of experience in Ontario and elsewhere, a review of the literature, and the values used in this study for the effectiveness of each measure for diverting waste.

Although considerable effort has been made to base the estimates of the expected effectiveness of each measure on the best information available, in many cases the values chosen are little more than educated guesses. One of the advantages of using a simulation model to analyze the impact of alternative measures and programs is that alternative assumptions about the 'diversion parameters' (used to quantify the impact of each measure on waste diversion) can be examined with relative ease. The diversion potential chosen for each measure reflect the waste generation and diversion patterns in Ontario as of December 31, 1990.

Another consideration is that the assessment of each policy measure given in Appendix A assumes that each measure is implemented alone. However, in many cases the combined

effect of two or more measures is not a simple addition of their individual effects since many measures act on the same waste stream component. For example, a deposit-refund system on glass bottles will encourage people to return them for reuse. The *Blue Box* program encourages people to recycle the glass. Since any one bottle can either be reused or recycled, the combined effect of a *Blue Box* program and a deposit-refund system cannot be estimated by adding their individual effects together. The waste management policy model makes provision for substitution or complementary among measures.

3.2 Scenario definition

Five different policy scenarios have been developed and analyzed. These are:

- a current trend scenario which includes measures in place in Ontario by December 31, 1990;
- Ontario's waste reduction action plan scenario which includes those measures contained in *An Ontario Waste Reduction Action Plan* (February, 1991);
- a economic measures scenario which includes only measures which utilize economic or market based incentives;
- a regulatory measures scenario which includes only measures which specify actions required by law; and
- a combined regulatory and economic measures scenario which includes a selection of economic incentives and regulation.

The regulatory (WRAP plus more regulatory measures) and combined (WRAP plus more regulatory and economic measures) scenarios build upon the waste diversion measures proposed in WRAP.

Current Trend Scenario

The current trend scenario includes all the measures in place in the province as of December 31, 1990.

Ontario waste reduction action plan

The following measures were included in the Ontario waste reduction action plan scenario:

- Mandatory source separation
- Industrial waste audits
- Yard and organic waste collection programs
- Education programs
- Expanded *Blue Box* programs

Economic measures scenario

The following measures were included in the economic measures scenario:

- Deposit systems
- Subsidies to producers
- Increase municipal funding
- Landfill tipping fees
- Subsidized home composters
- Packaging taxes
- User charges
- Virgin materials taxes

Regulatory measures scenario

The following measures were included in the regulatory measures scenario:

- Education programs
- Landfill bans

- Yard and organic waste collection programs
- Industrial waste audits
- Mandatory processing of solid waste collected
- Expanded *Blue Box* programs
- Mandatory source separation
- Recycled content regulation

The regulatory measures scenario builds upon the WRAP scenario. The three additional measures are landfill bans, mandatory processing of solid waste collected and the imposition of recycled content regulation.

Selected combination of regulatory and economic measures

The following measures were included in the combined regulatory and economic measures scenario:

- Education programs
- Yard and organic waste collection programs
- Landfill bans
- Mandatory source separation
- Expanded *Blue Box* programs
- Virgin materials taxes
- Industrial waste audits
- User charges

The combined regulatory and economic measures scenario builds upon the WRAP scenario. The three additional measures to the WRAP scenario are landfill bans, virgin materials taxes and user charges.

3.3 Evaluation criteria

The scenarios were evaluated based on the following criteria:

Expected performance in meeting the waste diversion targets
First and foremost is the question of whether a scenario is expected to meet the government's waste diversion targets. The extent to which this is achieved is one of the direct outputs of the waste management policy model.

Waste management costs and revenues
Each scenario affects the costs of waste management (i.e. collection, reuse, recycling, landfill and incineration) and revenues from waste management (i.e. from the sale of recycled products). Also, there are significant implementation costs for several of the measures. Each scenario was evaluated using the WMPM for its impact on the costs of waste management in Ontario for the years 1992 and 2000, including implementation costs, the revenues from the sale of recycled materials and the total costs of waste management. The total cost of waste management includes: the administration, collection, transportation, and landfill (or incineration) cost of waste disposal and the administration, collection, processing, and handling and transportation cost, less revenue from the sale of materials, of waste recycling.

The WMPM does not distribute waste management costs between various levels of government and the private sector. However, the cost of residential waste management in Ontario is assumed to be incurred at the municipal level. The costs of IC&I waste management are incurred by both municipalities and the private sector. Recycling costs are paid by both levels of government and the private sector. The WMPM assumes all program implementation costs are paid by the provincial government.

The total costs of waste management in Ontario equals the costs of waste management plus the policy scenario implementation costs.

Consequences for the Ontario economy
The consequences for the Ontario economy as-a-whole of each policy scenario include the evaluation of the impacts on: gross provincial product, value added, labour income, tax revenues and employment. All of these are estimated for each scenario using the macroeconomic impacts model (a modified input-output model) based on the waste diversion and waste management costs calculated by the WMPM.

Consideration of the consequences of the current recession on scenario results was built into the macroeconomic model by using conservative forecasts of economic variables. These forecasts are assumed to encompass the effects of recession on both waste generation and diversion. The current recession is not considered explicitly in the model.

Exports of waste between Ontario municipalities or out-of-province was not considered in the macroeconomic forecast. For all commodities the macroeconomic forecast assumes the historical trend values for exports and imports into and out of Ontario, for in addition, the impacts of a 25 per cent reduction in exports of pulp and newsprint were analyzed based on the assumption that the United States will implement similar paper recycling programs to Ontario resulting in lower export demand for virgin pulp and newsprint due to the processing and use of recycled fibres within the foreign domestic market.

Effect on the environmental protection industry
The waste diversion policy scenarios affect the environmental protection industry (EPI) three ways; i) increasing demand for EPI services in the waste management sector, ii) changing the type of EPI services demanded by the waste management sector (from waste disposal to recycling), and iii) changing demand for EPI services elsewhere in the economy. The effect of each scenario on the Ontario EPI is seen indirectly through increased economic activity in the transportation sector and changes in the types of activities in the waste management sector.

Effect on small business
The effect of each policy scenario on small business is included in the analysis using the macroeconomic impacts model. Small business impacts are expected to follow sectoral and regional trends.

Effect on consumer prices
The consequences of each policy scenario on consumer prices are reflected in the change in value added estimated using the macroeconomic impacts model.

Consequences for specific regions and sectors
The economic consequences of each scenario are not uniform. They vary from region to region and sector to sector. Estimates of these provincial impacts for six regions and 25 industrial sectors are provided by the macroeconomic impacts model. Specifically, the macroeconomic model estimates changes in employment by sector and region. It also estimates the impact on the waste management sector including the production and utilization of selected recyclable materials.

Regional provincial impacts are distributed using economic base share coefficients of employment by industrial sector for each municipality within the particular region.

4 Waste management policy model

4.1 Purpose of the model

The *Waste Management Policy Model* (WMPM) was developed to assist in the analysis of the economic and physical impacts of different combinations of measures which achieve the Ontario Ministry of the Environment's waste diversion targets. The impacts are analyzed based on:

- reduction, re-use, and recycling;
- incineration; and
- landfill.

The model is designed to analyze 22 different types of waste at the provincial level and permits the user to:

- analyze the effects of combining different measures; and
- determine the waste quantities diverted by combining measures.

The modelling is based on a current trend of waste generation and diversion for the years 1987, 1989, 1992 and 2000 developed by RIS (1991) and modified to account for waste

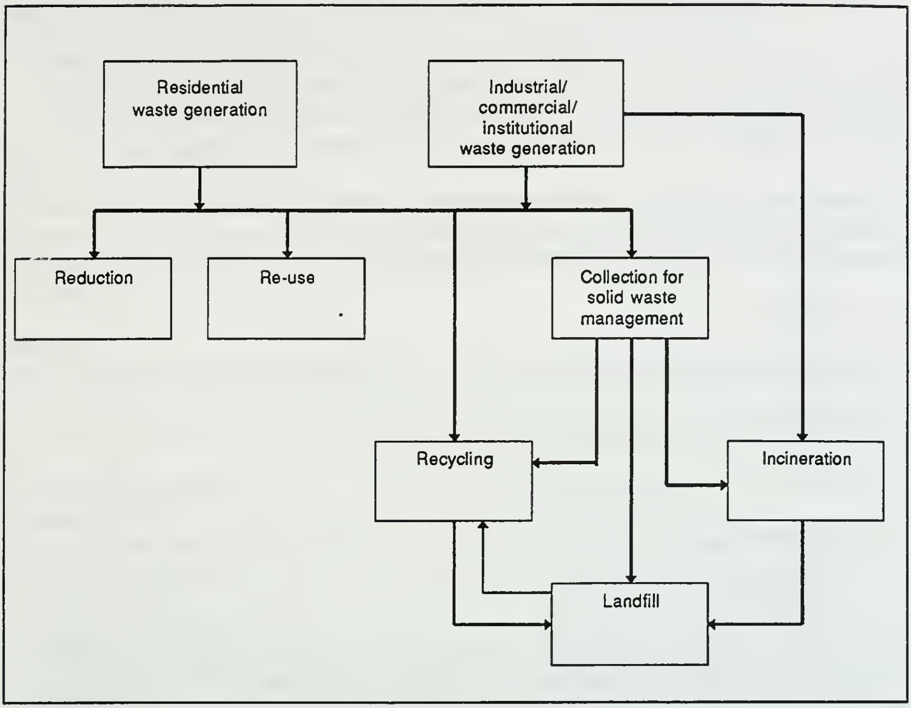

Figure 1
Schematic representation of waste management policy model

reduction over the period studied.[9] Waste generation in 1992 and 2000 is based on population growth and 1987 per capita waste generation.

The following is a description of the structure, use, inputs and outputs of the WMPM. A more detailed description of the operation of the model and output tables are found in Appendix B.

9 Waste reduction equals the difference between RIS (1991) estimate of waste generation for 1992 and 2000 and the per capita waste generation calculated for measuring the Ministry's diversion targets.

4.2 Description and structure of the model

The WMPM is a menu driven program which uses prompts to lead the user from data input to scenario analysis to results of the effects of different waste diversion scenarios. The user defines the structure of the model and adjusts the model's parameters. The model was designed and operates using *Lotus 1-2-3 Version 2.2* (*Lotus*).

The basic framework of the WMPM is presented in Figure 1.

The model divides waste management into six sectors:

- residential;
- industrial/commercial/institutional;
- collection for solid waste management;
- recycling;
- incineration;
- and landfill.

Solid waste from the residential sector is diverted through reduction, reuse and recycling with the balance collected for disposal at landfills or incineration. The IC&I sector is identical to the residential sector, with the addition of the potential diversion to private incineration. Waste management options for the recycling and solid waste management sectors are identical - wastes are either recycled, incinerated or landfilled. Incineration and landfill are assumed to be *inactive* sectors where the waste flow ends.[10] The export of waste from Ontario was not included as a waste management option and as such excluded from both the WMPM and macroeconomic analysis.

The model is designed as a *once-through* system. Waste diversion policy analysis is at the provincial level only. Detailed county or regional data of waste composition, generation and diversion were not available for inclusion in the model. All waste that is produced by the residential and IC&I sectors will flow through the system until it is landfilled. Any indirect effects that may occur through reusable containers and/or recycled items is accounted for through the diversion parameters which show what proportion of the waste

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[10] The model does account for the waste that is generated from incineration (i.e. ash) or recycling activities (waste residuals) which go to landfill.

components is reduced, reused and recycled. Menus incorporated into the model permit changes in the waste components and adjustment of the diversion parameters.

4.2.1 Measure analysis

A total of 18 waste diversion measures were developed for analysis in the model. The measures and their expected action are presented in Table 8. Measures may be combined and the efficiency of measures and other analytical parameters contained in the model can be changed.

Table 8
Waste diversion measures and actions

Economic measures	**Expected action**
Deposit systems	Reuse and recycling
Increase municipal funding for 3R's	Reuse and recycling
Landfill tipping fees	Reduction, reuse and recycling
Packaging taxes	Reduction and recycling
Subsides to producers	Reduction, reuse and recycling
Subsidised home composters	Reduction
User charges	Recycling and reduction
Virgin materials taxes	Recycling
Regulatory measures	**Expected action**
Changing product specifications	Reduction
Education programs	Reduction, reuse and recycling
Expanded "blue box" system	Recycling
Industrial waste audit	Reduction and recycling
Landfill bans	Reduction and recycling
Mandatory processing of solid waste	Reduction and recycling
Mandatory source separation	Recycling
Product bans	Reduction
Recycled content regulation	Recycling
Yard and organic waste collection	Reduction

For each measure diversion parameters (the share of total waste diverted by recycling, reuse and source reduction) are assigned to each waste component in the residential, IC&I, recycling, and landfill or incineration sectors. The waste diversion parameters assigned are for a specific measure by waste component. The diversion parameters were developed based on a survey of the literature found in Appendix A. An explanation of how the diversion parameters are derived is found in section 4.4.1. The model allows the measures to be weighted according to their importance and calculates an average weighted diversion parameter resulting from any combination of measures used for scenario analysis for each waste component and diversion category.

4.2.2 Waste components

The waste components analyzed by the model are defined by the list of key materials targeted for diversion from landfill and incineration for this study. Table 9 lists the waste components used in the model for the analysis of waste diversion in Ontario.

4.3 Model use

The analysis of the effect of combining measures and the determination of the quantities of waste diverted are handled separately by two individual *Lotus* worksheets; each worksheet acts as a sub-program, relying on data created by the other. The two sub-programs are provided as options from the main menu invoked when the file *MENU.WK1* is retrieved. The following is a description of the use of the model.

4.3.1 OPTIONS sub-program

The *OPTIONS* sub-program permits the analysis of the effects of combining measures. Figure 1 presents the structure of the *OPTIONS* sub-program.

The user can select up to eight measures for analysis within a waste diversion scenario. Several factors which effect the effectiveness of the selected measures can then be defined by the user.

Policy Ranks, the order of measure selection is important. Generally,.the measure selected first has the most "weight". Also, the substitutional/complementary nature of measures is relative to the first measure on the list. Measure ranks are arbitrary, with higher numbers having more rank than lower numbers. The highest rank for any measure is 8.

Table 9
Waste components included in the WMPM

• Old newspaper (ONP)
• Fine paper
• Boxboard
• Old corrugated cardboard (OCC)
• Mixed paper
• Magazines
• Telephone books
• Glass containers
• Plastics
• Composite packaging
• Aluminum
• Tinplate and steel
• White goods
• Used tires
• Yard waste
• Food waste
• Wood waste
• Construction/demolition waste
• Disposable diapers
• Foundry sands
• Asphalt
• Other waste

Factors, some measures complement others, while some are pure substitutes. Complementary measures are those where the waste diversion effects of one measure can be added to the waste diversion effects of another measure. For example, the waste diversion potential of education programs complement enhanced blue box programs. When two measures are complements, the diversion parameters are combined using one of several formulae that can be chosen by the user. Substitute measures are those where the waste diversion effects of one measure cannot be added to the waste diversion effects of another measure. For example, the waste diversion potential of deposit systems substitute for enhanced blue box programs (the same waste cannot be recovered twice). When two measures are substitutes, the model selects the measure with the higher diversion

parameter. The model provides the ability to change the combined effects of complementary measures.

The criteria for determining if two measures are complements or substitutes are as follows:

- Do the measures affect the same sectors?

- Do the measures affect any of the same waste components?

- Do the measures affect relatively the same portion (amount) of the one waste component?

- Do the measures affect the same portions (amount) of the waste components? For example, do landfill bans and virgin material taxes both effect the same portion of glass containers, old newspapers, and yard waste?

A further explanation of how policy measures are categorized as complements or substitutes is found in Appendix B.

Formulae, There are a number of ways in which the complementary effects of measures may be considered. Four formulae are provided: each treats complement and substitute measures differently.

- Some partial complements: effectiveness of complementary measure reduced by diversion from previously implemented measures (measure effects are multiplicative).

- Substitutes with perfect complements: substitute measures are never added and complement measures are additive).

- No complements: all the measures are substitutes (measure effects are never additive).

- Complements only: all measures are perfect complements (measure effects are additive).

Efficiencies, the effectiveness of any given measure can be globally improved or reduced by altering its efficiency. All diversion parameters for all sectors and years are multiplied by this efficiency (normally 100 per cent) before the final analysis. The efficiency factor for each measure may be set by the user. Typically, the user would set the efficiency for each measure somewhere between 0 and 1 (0 per cent and 100 per cent efficiency). However the efficiency of a measure can be set in excess of 100 per cent or less than 0 per cent. For example, the user may wish to examine a measures's effect if the diversion

for all waste types and sectors were 200 per cent, or double the diversion originally specified for the measure.

Table, is a symmetric table which defines the substitutional/complementary relationship between measures. Table 10 presents the substitution/complement table defined for the 18 measures used for this study.

Table 10
Complements/substitutes matrix — waste management policy model

Substitute-Complement Table - Symmetric, but not case-sensitive.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DEPOSIT SYSTEMS	1	S	C	S	C	S	S	S	C	S	S	S	S	S	S	S	S	S	S
EDUCATION PROGR	2	C	S	C	C	C	S	C	C	C	C	S	C	C	C	C	C	C	C
EXPANDED BLUE B	3	S	C	S	S	S	S	S	C	S	C	S	C	S	C	S	S	S	C
INCREASE MUNICI	4	C	C	S	S	S	S	S	S	S	C	S	C	S	S	S	S	S	C
INDUSTRIAL WAST	5	S	C	S	S	S	S	S	C	S	C	C	C	C	S	S	S	S	S
LANDFILL BANS	6	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
LANDFILL TIPPIN	7	S	C	S	S	S	S	S	S	S	C	C	S	S	S	S	S	S	S
MANDATORY PROCE	8	C	C	C	S	C	S	S	S	C	S	S	S	S	S	S	S	S	S
MANDATORY SOURC	9	S	C	S	S	S	S	S	C	S	C	C	C	C	S	S	S	S	S
PACKAGING TAXES	10	S	C	C	C	C	S	C	S	C	S	S	S	C	S	C	S	S	C
PRODUCT BANS	11	S	S	S	S	C	S	C	S	C	S	S	S	C	S	C	C	S	S
PRODUCT SPECIFI	12	S	C	C	C	C	S	S	S	C	S	S	S	S	S	S	S	S	S
RECYCLED CONTEN	13	S	C	S	S	C	S	S	S	C	C	C	S	S	S	S	S	S	S
SUBSIDISED HOME	14	S	C	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
USER CHARGES	15	S	C	S	S	S	S	S	S	S	C	C	S	S	S	S	S	S	S
VIRGIN MATERIAL	16	S	C	S	S	S	S	S	S	S	S	C	S	S	S	S	S	S	S
YARD AND ORGANI	17	S	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
SUBSIDIES TO PR	18	S	C	C	C	S	S	S	S	S	C	S	S	S	S	S	S	S	S

Once all measures are selected and ranked, complementary factors and efficiencies set as desired, the model analyzes the cumulative effects of combined measures. Results are then exported by the user for quantitative analysis, viewing and printing in the *RESULTS* sub-program.

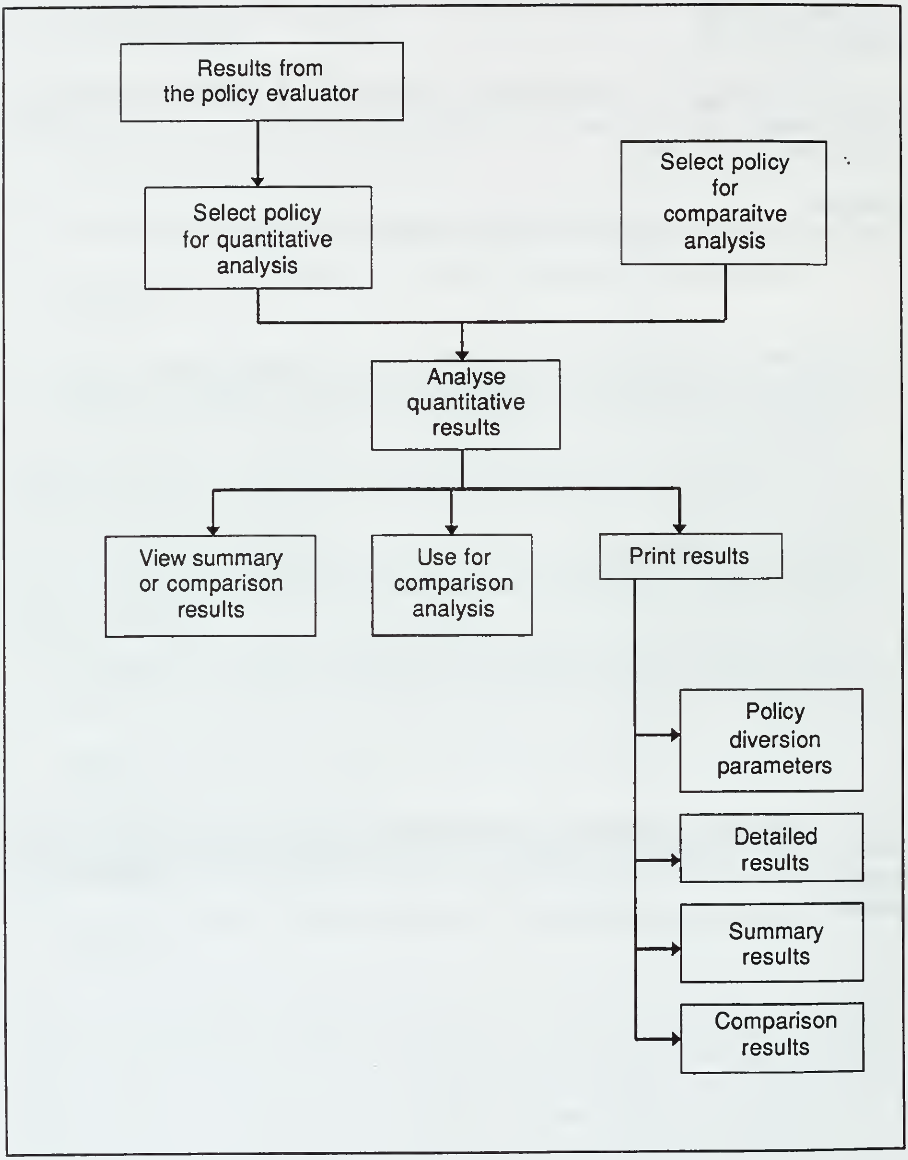

Figure 2
Policy results evaluator

4.3.2 RESULTS sub-program

Once a combination of measures has been analyzed in the *OPTIONS* sub-program, the quantitative effect of diverting wastes can be examined in the *RESULTS* sub-program. Figure 2 presents the structure of the *RESULTS* sub-program.

RESULTS calculates the quantity of waste sent to each waste management option, in each sector, for all years (in tonnes). The user may view a summary of these results or a comparison of the results with the current trend or the results of other measures or scenarios.

The detailed results for each measure can be printed. All output is formatted by the *Lotus* add-in program *Allways*. A total of four different sets of tables are provided:

- *Diversions*, tables of the raw percentages calculated by the *OPTIONS* sub-program;
- *Results*, tables of the actual quantities going to each waste management option for each waste stream, sector, and year;
- *Summary*, this output is identical to the summary tables viewed on screen; and
- *Comparison*, the comparison of the results with the current trend scenario.

4.4 Model inputs and outputs

There are five types of data required for operation of the model:

- estimates of population and employment in 1992 and 2000;
- diversion parameters for each measure for each waste component for each sector;
- unit costs of diversion, incineration and landfill for each waste component;
- implementation costs of the measures; and
- current trend waste generation and diversion quantities (See, Appendix C).

The output of the model may be viewed on the screen of the computer or printed.

4.4.1 Diversion parameters

For each of the residential, IC&I, landfill, incineration and recycling sectors diversion parameters are assigned to each waste type under the current trend and for each measure. For the residential and IC&I sectors, the diversion parameters define what proportion of the waste stream is reduced[11], reused and recycled; the remaining waste is assumed to be collected for landfill or incineration. An example of the waste diversion parameters for expanded *Blue Box* programs in the residential sector for 1992 and 2000 are presented in Table 11.

Waste diversion parameters calculation

Waste diversion parameters can vary between -1.0 and +1.0, where a negative value indicates a diversion away from a waste handling method and a positive value indicates a waste diversion to that method. The waste diversion parameters for each measure are calculated by waste handling method and by waste component. The expected total additional diversion of a waste component, j, by waste handling method, i, is calculated as follows:

$$TD_{ij} = T_{ij} + (d_{ij} \times T_{ij}) \tag{1}$$

where,

- i = the five methods of handling waste included in the model: reduction; reuse; recycling; incineration; and landfill.
- j = the 22 waste components included in the model.
- TD_{ij}= the additional proportion of waste component, j, diverted from landfill and incineration resulting from waste handling method, i.
- d_j = the additional proportion of waste component, j, diverted from landfill and incineration.
- T_{ij} = the current proportion of waste component, j, diverted away from landfill and incineration using waste handling method, i.

Table 12 illustrates an example of the calculation of waste diversion parameters if a waste component is diverted from landfill by two waste diversion methods. The current trend diverts 10 per cent of waste through source reduction and 20 per cent of waste by recycling from landfill (the remaining waste, 70 percent, is landfilled). If a new waste diversion measure is implemented, an additional 10 per cent (0.1) of waste will be diverted from landfill. Of the additional waste diverted, 30 per cent will be by source reduction and 70 per cent by recycling. The revised total proportion of waste diverted by

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[11] For example, through light-weighting, less packaging or changing product specifications.

Table 11
Residential waste diversion parameters based on an expanded *blue box* program

Waste component	1992 diversion parameter				2000 diversion parameter			
	Reduction	Re-use	Recycling	Disposal	Reduction	Re-use	Recycling	Disposal
ONP	0%	0%	100%	-8%	0%	0%	100%	-14%
Fine paper	0%	0%	100%	-15%	0%	0%	100%	-25%
Boxboard	0%	0%	100%	-10%	0%	0%	100%	-18%
OCC	0%	0%	100%	-9%	0%	0%	100%	-28%
Mixed paper	0%	0%	0%	0%	0%	0%	0%	0%
Magazines	0%	0%	100%	-7%	0%	0%	100%	-12%
Telephone books	0%	0%	100%	-10%	0%	0%	100%	-16%
Glass containers	0%	0%	100%	-12%	0%	0%	100%	-13%
Plastics	0%	0%	100%	-4%	0%	0%	100%	-15%
Composite packaging	0%	0%	0%	0%	0%	0%	0%	0%
Aluminium	0%	0%	100%	-12%	0%	0%	100%	-19%
Tinplate, steel	0%	0%	100%	-17%	0%	0%	100%	-19%
White goods	0%	0%	0%	0%	0%	0%	0%	0%
Used tires	0%	0%	0%	0%	0%	0%	0%	0%
Yard waste	0%	0%	0%	0%	0%	0%	0%	0%
Food waste	0%	0%	0%	0%	0%	0%	0%	0%
Wood waste	0%	0%	0%	0%	0%	0%	0%	0%
Construction/Demolition Waste	0%	0%	0%	0%	0%	0%	0%	0%
Disposable diapers	0%	0%	0%	0%	0%	0%	0%	0%
Foundry sand	0%	0%	0%	0%	0%	0%	0%	0%
Asphalt	0%	0%	0%	0%	0%	0%	0%	0%
Other	0%	0%	0%	0%	0%	0%	0%	0%

Source:
Waste Management Policy Model.

Note: Diversion parameters are interpreted as follows, for example, for ONP in 1992, the expanded *blue box* program will divert an additional 8 per cent of total ONP away from disposal and 100 per cent of this amount will be sent for recycling.

each waste handling method is 13 percent from source reduction (0.1 (from current trend) plus (0.3 times 0.1)) and 27 per cent from recycling (0.2 (from current trend) plus (0.7 times 0.1)).

Table 12

Example calculation of waste diversion parameters

	Variable name	Proportion of waste diverted by source reduction	Proportion of waste diverted by recycling	Proportion of waste going to landfill
Current trend	T_{ij}	0.1	0.2	0.7
New waste diversion measure	d_j	0.3	0.7	0.1
Revised total of waste diverted	TD_{ij}	0.03	0.27	0.6

The diversion parameters for each measure are estimated based on information collected from a review of the literature and are presented in Appendix A.

4.4.2 Total waste management costs

Unit costs

Unit costs of waste diversion and disposal are included in the WMPM. The cost of incineration and landfill equals the sum of:

- collection cost;
- transportation cost;
- landfill cost.

It is assumed that the costs for diversion through waste reduction are zero since these costs are typically associated with changes in production process or social behaviour. The costs of reuse are also assumed to be zero except for glass containers, where data are available regarding the cost of reuse.

There is both a cost and revenue stream per tonne for recycled materials. Costs for recycled materials equals the sum of:

- collection cost;
- transportation cost;
- processing and handling cost;
- administration cost.

Revenues are the price secondary materials re-processors offer for recyclable materials collected and sorted. Cost and prices are in 1989$ for the years 1992 and 2000.

The public sector is assumed to incur all the costs and receive all the revenues of municipal solid waste management in Ontario. Waste management costs are financed from general municipal revenues, the sale of recyclable materials and provincial government funding (provided from the Province's Consolidated Revenue Fund) of specific waste diversion programs (VHB and MacLaren Engineers 1991; 51). At present, no municipality in Ontario has implemented residential user charges. Typically, tipping fees (municipal revenues) in the Province apply to waste received from industrial and commercial sources. These private sector costs (tipping fees) are not included in the WMPM for analysis for the following reasons:

- tipping fees revenue are not designated for waste management but placed in general revenues;
- tipping fees are applied to only a part of the IC&I waste stream (VHB and Maclaren Engineers 1991; 46), the amount of waste by waste type is not known; and
- any private sector costs of hauling and disposing/reducing waste are considered operating expenses and implicitly included in the input/output model used for the macroeconomic impacts analysis (inclusion of these costs in the WMPM would result in double-counting).

Unit cost calculation

Waste management costs are calculated by waste handling method and waste component in 1989$/t.

Total waste management costs = Total reduction cost +
Total reuse cost +
Total recycling cost +
Total incineration cost +
Total landfill cost

The cost of each waste handling method is calculated as follows:

$$TC_{ij} = \sum c_{ij} \times w_{ij}$$

where,

TC_{ij} =	the estimated total cost (1989$) of diverting or disposing of waste component, j, through waste handling method, i.
w_{ij} =	is the amount of a specific waste component, j, in tonnes diverted or disposed by waste handling method, i.
c_{ij} =	is the estimated cost per tonne for disposing or diverting waste component, j, by diversion or disposal method i.

Table 13 presents the unit costs used in the Model.

4.4.3 Measure implementation costs

The measure costs of implementing waste diversion measures are not calculated by the WMPM. These costs are estimated outside the WMPM and are presented separately in the results (Table 14). The implementation costs include the operating, and where necessary, capital costs of the measure beyond current and planned expenditures of the government for the years 1992 and 2000. Capital costs are annualized at a discount rate of 6 per cent over a 20 year period (VHB 1991).

Normal government costs and expenditures for administration and monitoring measures or programs undertaken by current staff are excluded from the estimation of implementation costs. The cost of implementing the measures are estimated based on the diversion potential in tonnes of each measure as calculated by the WMPM and expected measure costs provided from the literature (except for education programs and subsidized home composters whose costs are based on number of households).

Table 13
Estimated cost and revenues in 1992 and 2000 of waste diversion by waste component.[1]

Costs/tonne (1989$)	ONP	Fine Paper	Boxboard	OCC	Mixed Paper	Magazines	Telephone Books	Glass Containers	Plastic (rigid & film)	Composite Packaging	Aluminium Cans & Foil
Reduction	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Reuse	$0	$0	$0	$0	$0	$0	$0	$200	$0	$0	$0
Recycling[2]	$163	$209	$156	$156	$156	$156	$156	$147	$289	$289	$378
Incineration[3]	$111	$111	$111	$111	$111	$111	$111	$111	$111	$111	$111
Landfill[4]	$84	$84	$84	$84	$84	$84	$84	$84	$84	$84	$84
Revenues/tonne (1989$)[5]	**ONP[6]**	**Fine Paper[6]**	**Box-board[10]**	**OCC[6]**	**Mixed Paper[6]**	**Maga-zines[10]**	**Telephone Books[10]**	**Glass Contain-ers[7]**	**Plastic[9] (rigid & film)**	**Composite Packaging**	**Aluminium Cans & Foil[7]**
Reduction	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Reuse	$0	$0	$0	$0	$0	$0	$0	$165	$0	$0	$0
Recycling	$51	$187	$39	$62	$10	$9	$11	$66	$343	$0	$1,669
Incineration	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Landfill	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Costs/tonne (1989$)	Tinplate, Steel Cans	White Goods	Used Tires	Yard Waste	Food Waste	Wood Waste	Constructio n/ Demolition	Disposable Diapers	Foundry Sands	Asphalt	Other
Reduction	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Reuse	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Recycling[2]	$147	$147	$200	$129	$129	$129	$129	$289	$129	$129	$129
Incineration[3]	$111	$111	$111	$111	$111	$111	$111	$111	$111	$111	$111
Landfill[4]	$84	$84	$84	$84	$84	$84	$84	$84	$84	$84	$84
Revenues/tonne (1989$)[5]	**Tinplate, Steel Cans[7]**	**White Goods**	**Used Tires[8]**	**Yard Waste**	**Food Waste**	**Wood Waste[7]**	**Constructio n/ Demolition**	**Disposable Diapers**	**Foundry Sands**	**Asphalt**	**Other**
Reduction	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Reuse	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Recycling	$80	$28	$64	($28)	($28)	$7	($65)	$0	$0	$0	$0
Incineration	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Landfill	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Notes:

1. Estimated cost = processing and handling + transport cost + collection cost + administration cost
   - Administration cost (excluding incineration and landfill) = 0.25 X (processing/handling + collection cost)
   - Collection costs = $35.4/t for incineration and landfill (Resource Integration Systems 1990).
   - Collection costs = $79.02/t for recyclable materials (Environmental Defense Fund 1990). Collection cost is an average; actual costs vary by type of waste material collected.
   - Transportation costs = $12.5/t for a 30 - 60 kilometre haul (CH2M Hill 1991).
2. Processing/sorting costs per tonne vary by waste material (State of Washington 1989).
3. Incineration cost = $63.5 per tonne (CH2M Hill 1991: 4-22).
4. Landfill cost = $36.1 per tonne (CH2M Hill 1991: 4-17).
5. Revenues per tonne vary by waste material (Resource Integration Systems and VHB Research and Consulting 1991).
6. Revenues, weighted averages, 1981 to 1988 (Resource Integration Systems and VHB Research and Consulting 1991).
7. Revenues, quoted current prices (Resource Integration Systems and VHB Research and Consulting 1991).
8. Revenues from Resource Integration Systems and VHB Research and Consulting (1991) and Pilorusso and VHB research and Consulting (1990).
9. Average price, 1988 - 1990, PET plastic (CH2M Hill 1991).
10. Quoted prices in RECOUP for 1989.

Table 14
Example of WMPM *View* option - comparison of education programs with the current trend

25	COMPARISON:	EDUCATION PROG	vs.	CURRENT TREND	
26		1992	2000	1992	2000
27	RESIDENTIAL				
28	Generation	4 231 989	4 601 053	4 231 989	4 601 053
29	Reduction	218 662	194 130	87 329	90 755
30	Reuse	17	18		
31	Sent to Recycling	701 194	1 320 958	649 802	1 249 966
32	Landfill	3 312 117	3 085 947	3 494 859	3 260 332
33	Total Diversion	919 872	1 515 106	737 131	1 340 721
34	Percent Diversion	22%	33%	17%	29%
35	INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
36	Generation	5 649 671	5 986 861	5 649 671	5 986 861
37	Reduction	209 956	148 779	126 451	75 565
38	Reuse	1 561	781		
39	Sent to Recycling	678 600	1 164 274	564 750	1 069 924
40	Incineration				
41	Landfill	4 759 554	4 673 028	4 958 470	4 841 372
42	Total Diversion	890 117	1 313 833	691 201	1 145 489
43	Percent Diversion	16%	22%	12%	19%
46	RECYCLING				
47	Received for Recycling	1 506 794	2 714 568	1 328 934	2 538 396
48	Recycled	1 379 794	2 485 232	1 214 552	2 319 890
49	Incineration				
50	Landfill	127 000	229 336	114 382	218 506
51	Total Diversion	1 379 794	2 485 232	1 214 552	2 319 890
52	Percent Diversion	92%	92%	91%	91%
53	SOLID WASTE MANAGEMENT				
54	Received for Disposal	8 071 671	7 758 974	8 453 329	8 101 704
55	Incineration				
56	Landfill	8 071 671	7 758 974	8 453 329	8 101 704
57	Sent to Recycling				
58	Percent Diversion	0	0%	0%	0
59	SUMMARY - ALL WASTE				
60	Total Waste Generated	9 881 660	10 587 914	9 881 660	10 587 914
61	Total Waste Diversion	1 809 989	2 828 940	1 428 331	2 486 210
62	Percent of Waste Diver	18%	27%	14%	23%

64	COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
65	1992 COSTS OF WASTE MANAGEMENT	EDUCATION PRO	CURRENT TREND	DIFFERENCE
66	Reduction			
67	Reuse			
68	Recycling	$147 307	$133 039	$14 268
69	Incineration			
70	Landfill	$678 032	$710 092	-$32 060
71	TOTAL	$825 338	$843 130	-$17 792
72	INCREMENTAL POLICY IMPLEMENTATION	EDUCATION PRO	CURRENT TREND	DIFFERENCE
73	EDUCATION PROGRAMS vs.	$14 368		$14 368
81	TOTAL IMPLEMENTATION COSTS	$14 368		$14 368
83	COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
84	2000 COSTS OF WASTE MANAGEMENT	EDUCATION PRO	CURRENT TREND	DIFFERENCE
85	Reduction			
86	Reuse			
87	Recycling	$276 623	$266 402	$10 221
88	Incineration			
89	Landfill	$651 765	$680 555	-$28 790
90	TOTAL	$928 388	$946 957	-$18 569
91	INCREMENTAL POLICY IMPLEMENTATION	EDUCATION PRO	CURRENT TREND	DIFFERENCE
92	EDUCATION PROGRAMS vs.	$16 118		$16 118
100	TOTAL IMPLEMENTATION COSTS	$16 118		$16 118

Seven measures require additional implementation costs:

- Education;
- Expanded Bluebox programs;
- Increased funding to municipalities for reduction and recycling programs;
- Subsidies to producers;
- Mandatory processing of solid waste collected;
- Subsidized home composters;
- Organic waste collection.

The remaining 11 measures are assumed not to require any new costs for their implementation. The cost of implementing a combination of measures is assumed to be the addition of each measures implementation costs.

4.4.4 Model results

Output from the model reflects the quantities of waste diverted by the selected measures and model options. Waste quantities generated and diverted are shown along with the current trend levels of waste generation and diversion. The unit costs and revenues, including waste management savings, are also estimated. The estimated implementation costs of each selected measure are also included in the results.

The user may view the scenario results through two options: *Summary* results of the scenario or a *Comparison* of the results with the current trend. As an example, Table 14 presents a comparison of the results of an expanded education program. Detailed results may be printed.

Four *Print* options are provided in the WMPM. For each option, the user is asked if output should be directed directly to the printer or to a file. All output is formatted by the *Lotus* add-in program *Allways*. The program assumes that *Allways* has been correctly configured for the printer available. The following tables from the model may be printed:

- Diversions parameters by waste type and sector in raw percentages as calculated by the *OPTIONS* sub-program.

- Forecasts of the quantities going to each waste management option for each waste stream, sector, and year.

- Summary of the waste diverted and costs similar to the results presented in Table 14.

- Comparison of the waste diverted and costs as presented in Table 14.

4.5 Limitations of the model

There are several limitations to the model:

- Model results are sensitive to the selection of the diversion parameters. Where possible, diversion parameters are based on empirical studies and current research. In some instances professional judgement was required to estimate the value of some diversion parameters and measure costs. It is expected that these values will require periodic updating.

- The model is non-optimizing. In other words the most effective or efficient scenario for achieving a waste diversion objective is not determined by the model. Instead, the model provides an estimate of the cost and waste generation patterns associated with alternative policies. Near-optimum policies can be determined through repeated analysis and comparisons of alternatives.

- The handling of some waste types are not easily incorporated into the model. For example, scrap tires are typically stored in piles and not incinerated, landfilled or diverted. For this study such wastes are included in landfill.

- The model provides scenario output for only two time periods.

- All cost data used in the model must be annualized by the user prior to use in the model.

5 Meeting the targets

5.1 Current trend

The current trend used in the WMPM is based on the reconciliation of the residential sector and the IC&I sector waste generation estimates for 1989 developed by CH2M Hill (1991) and RIS (1991) for the Province (Table 15), and assumes that there are no new waste management policy initiatives after December 31, 1990. For the most part CH2M Hill's estimates of residential waste generation and RIS's IC&I waste generation estimates were used in the WMPM. RIS (1991) estimates of the amount of waste diverted for recycling in 1992 and 2000 were altered to reflect the residual waste generated from the processing and sorting of recyclable materials. These residual waste diversion factors which result in lower current trend diversion rates than those presented in RIS (1991) are presented in Table 16.

The recycling waste residuals parameters are applied to the amount of the waste type directed for recycling. For example, the expanded blue box program will divert an additional 8 per cent of ONP from disposal to recycling (Table 11). The processing and sorting of ONP at the material recycling facility results in 95 per cent of ONP actually being recycled and 5 per cent being sent to landfill as recycling waste residual.

The current trend for 1992 and 2000 used in the WMPM are derived from RIS (1991) for both the residential and IC&I sectors. Figure 3 illustrates the current trend waste generation and diversion used in the WMPM. Based on the current trend it is projected that by 1992, 13 per cent of all waste generated in the Province will be diverted from landfill and incineration. By the year 2000 it is estimated that 23 per cent of waste will be

Table 15
Comparison and reconciliation of CH2M Hill and RIS estimates of 1989 waste generation in Ontario

Waste type		1989 residential sector waste generation (tonnes)		1989 IC&I sector waste generation (tonnes)		1989 WMPM waste generation (tonnes)	
		CH2M Hill	RIS	CH2M Hill	RIS	Residential sector	IC&I sector
Paper	Newsprint	673,200	400,000		170,000	400,000	170,000
	Fine paper	74,000	74,000		359,800	74,000	359,800
	Boxboard	173,100	173,100		333,900	173,100	333,900
	OCC	108,900	109,000	441,000	441,200	109,000	441,000
	Magazines	165,100	165,100		127,660	165,100	127,600
	Mixed paper	59,300	59,300		79,400	59,300	79,400
	Phone books	13,000	13,000		7,300	13,000	7,300
	Composite packaging	11,400				11,400	0
	Other paper	196,000		426,000		na	na
	Office paper			354,000		na	na
	Total paper	1,474,000	993,500	1,221,000	1,519,260	na	na
Glass	Food/Beverage containers	268,500	268,500		61,500	na	na
	Other	22,700				Other	Other
	Total glass	291,200	268,500	282,000	61,500	268,500	61,500
Tinplate steel	Food/Beverage containers	75,100	75,100		24,600	75,100	24,600
	White goods	101,400				101,400	0
	Other	56,300				Other	Other
	Total tinplate steel	232,800	75,100	0	24,600	na	na
Aluminum	Food/Beverage containers	13,500	13,500		15,400	na	na
	Other containers	10,400				Other	Other
	Foil	2,900	2,900		1,300	na	na
	Other	4,300				Other	Other
	Total aluminum	31,100	16,400	0	16,700	16,400	16,700
Total metals		263,900	91,500	599,000		na	na

Table 15
Comparison and reconciliation of CH2M Hill and RIS estimates of 1989 waste generation in Ontario (continued)

Waste type		1989 residential sector waste generation (tonnes)		1989 IC&I sector waste generation (tonnes)		1989 WMPM waste generation (tonnes)	
		CH2M Hill	RIS	CH2M Hill	RIS	Resident-ial sector	IC&I sector
Plastics	PET	3,800	3,540		390	na	na
	HDPE	11,500	17,440		21,770	na	na
	Other RPC	111,900	15,360		23,180	na	na
	Film	125,000	101,260		56,960	na	na
	Total plastics	252,200	137,600	163,000	102,300	137,600	102,300
Organics	Food waste	624,600	624,600		490,000	624,600	490,000
	Yard waste (leaves, grass)	489,500	654,400		110,000	654,400	110,000
	Yard waste (other)	164,900				Other	Other
	Total organics	1,279,000	1,279,000	600,000	600,000	na	na
Wood waste		46,700	46,700	1,130,000	1,439,700	46,700	1,439,700
Construct-ion and demolition	Drywall	11,500	11,500		129,600	na	na
	Other	52,100				Other	Other
	Total construction and demolition	63,600	11,500		129,600	11,500	129,600
Diapers		111,000	111,000		8,000	111,000	8,000
Used tires		800	800	88,000	88,200	800	88,000
Household hazardous wastes		23,400				Other	Other
Foundry sand					356,000	0	356,000
Other		247,400	1,112,900	1,278,000	1,015,140	1,000,300	1,015,400
	Total	4,053,200	4,053,000	5,361,000	5,361,000	4,053,200	5,361,000

Note:

na - Waste component not applied in WMPM. The WMPM was developed to use 22 waste types proposed by RIS (1991) in the early stages of its study and used by CH2M Hill (1991).

Other - Included in "Other" category.

Sources:

CH2M Hill 1991.

RIS 1991.

diverted (Table 17) without any new policy initiatives by the government.[12]

Table 16
Recycling waste residuals parameters by waste type

	1992		2000	
Recycling	**Recycle**	**Landfill**	**Recycle**	**Landfill**
ONP	95%	5%	95%	5%
Fine Paper	96%	4%	96%	4%
Boxboard	92%	8%	92%	8%
OCC	95%	5%	95%	5%
Mixed Paper	96%	4%	96%	4%
Magazines	92%	8%	92%	8%
Telephone Books	92%	8%	92%	8%
Glass Containers	92%	8%	92%	8%
Plastic (rigid and film)	100%	0%	100%	0%
Composite Packaging	92%	8%	92%	8%
Aluminium Cans, Foil	100%	0%	100%	0%
Tinplate, Steel Cans	94%	6%	94%	6%
White Goods	92%	8%	92%	8%
Used Tires	92%	8%	92%	8%
Yard Waste	90%	10%	90%	10%
Food Waste	90%	10%	90%	10%
Wood Waste	88%	12%	88%	12%
Construction/Demolition Waste	40%	60%	40%	60%
Disposable Diapers	92%	8%	92%	8%
Foundry Sands	92%	8%	92%	8%
Asphalt	92%	8%	92%	8%
Other	92%	8%	92%	8%

[12]The current trend is based on the policies in place at the end of 1990.

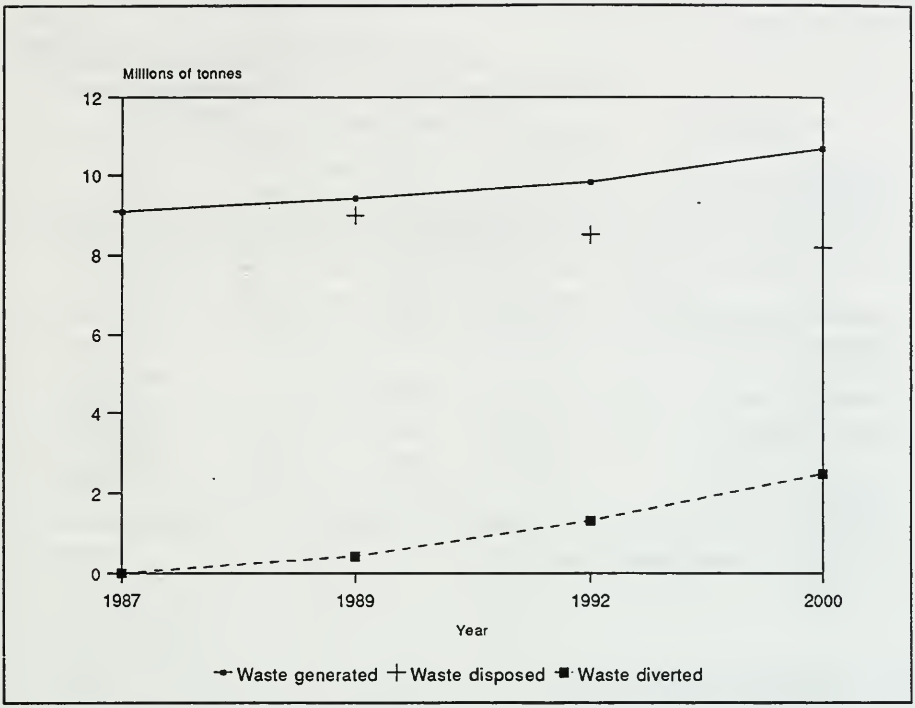

Figure 3
Current and forecast waste generation and diversion in Ontario

Table 17 presents the estimated cost of waste management based on the current trend projections. The total cost of waste management is the sum of the cost of waste management plus the incremental program costs. The cost of waste management for 1992 and 2000 is estimated to be $843 million and $947 million (1989$), respectively.

The level of waste diversion and costs of waste management estimated from the current trend projections for 1992 and 2000 are the basis for estimating the impact of additional waste management measures and scenarios.

A detailed profile of the current trend is found in Appendix C.

Table 17
Current trend and policy scenarios per cent waste diversion and increases in waste management costs

	Per cent of waste diverted		Total waste management costs (million 1989$)	
	1992	**2000**	**1992**	**2000**
Current trend	14%	23%	$843	$947
	Increase in the amount of waste diverted		**Increase in the total cost of waste management (million 1989$)**	
	1992	**2000**	**1992**	**2000**
Ontario's waste reduction action plan	11%	13%	$21	$36
Economic measures	11%	14%	$2	($5)
Regulatory measures	19%	24%	$60	$105
Selected combination of economic and regulatory measures	23%	25%	$42	$46

See Appendix C for details of scenario results.

5.2 Individual measures

The diversion potential of the individual measures was estimated utilizing the WMPM. The per cent increase in the amount of waste diverted by measure and the change in the costs of waste management are presented in Table 18.

All of the measures result in a net diversion of waste from disposal. User charges, industrial waste audits, mandatory source separating and landfill bans result in the largest diversion of waste, 7 per cent, by 2000. Other measures which result in a significant diversion of waste by the year 2000 are increased funding to municipalities (6 per cent), tipping fees (5 per cent) and mandatory waste processing (5 per cent). Except for municipal funding, these measures have not been extensively implemented in the Province.

The measures resulting in the least amount of waste diversion by the year 2000 are:

- deposit systems;
- product bans;

Table 18
Individual measures waste diversion and costs

	Per cent of waste diverted		Total waste management costs (000,000's 1989$)	
	1992	2000	1992	2000
Current Trend	14%	23%	$843	$947
Measure	Per cent incremental increase in waste diverted		Incremental change in total waste management costs (000,000's 1989$)	
	1992	2000	1992	2000
Deposit systems	1%	1%	($5)	($5)
Education Programs	4%	4%	($3)	($3)
Expanded *blue box* programs	1%	2%	$8	$10
Increased funding to municipalities	5%	6%	$12	$11
Industrial waste audits	5%	7%	($8)	($10)
Landfill bans	8%	7%	($12)	($9)
Landfill tipping fees	4%	5%	($2)	($6)
Mandatory processing of solid waste collected	1%	5%	$9	$51
Mandatory source separation	5%	7%	($11)	($13)
Packaging taxes	1%	2%	($3)	($6)
Product bans	1%	1%	($3)	($5)
Product specifications	1%	1%	($4)	($7)
Recycled content regulations	2%	2%	($4)	($4)
Subsidies to producers	3%	3%	($0)	($1)
Subsidised home compositors	1%	1%	($3)	($4)
User charges	5%	7%	($32)	($46)
Virgin materials taxes	3%	3%	($11)	($12)
Yard and organic waste collection programs	3%	3%	$20	$31

Note:
Costs include all waste management costs plus implementation costs where applicable.

Source:
Appendix C.

- product specifications; and
- home composters.

These measures all divert only about 1 per cent of total waste generated. The low diversion rates resulting from these measures can be attributed to the small portion of the total waste stream to which these measures apply. For example, an expanded deposit system is assumed to affect glass containers, plastic containers, aluminum cans, tinplate steel cans, composite packaging and scrap tires. Combined these waste types comprise only 8.5 per cent of total waste generation.

A total of 14 measures actually reduce the total cost of waste management. The least costly of these measures are as follows:

- user charges ($46 million savings in 2000);
- mandatory source separation of solid waste collected ($13 million);
- virgin material taxes ($12 million); and
- industrial waste audits ($10 million).

These cost savings are shared by both the public and the private sectors. Municipalities pay the costs of residential waste disposal, municipalities and the private sector share the costs of IC&I waste disposal and both levels of government and the private sector pay for the costs of recycling. The Province is assumed to incur all program implementation costs.

All of these measures are expected to divert waste through reduction or through the recycling of wastes with a strong demand in the secondary materials market. Mandatory source separation, user charges and industrial waste audits provide a waste diversion of greater than 5 per cent at a net savings in the cost of waste management.

The measures resulting in a net cost by the year 2000 are as follows:

- mandatory processing of solid waste collected ($51 million);
- yard and organic waste collection ($31 million);
- increased funding to municipalities for reduction and recycling programs ($11 million); and
- expanded *Blue Box* programs ($10 million).

These measures all require significant capital outlays (mandatory processing of solid waste collected and yard and organic waste collection) or additional provincial subsidies (increased municipal funding and expanded *Blue Box* programs).

Detailed descriptions of each measure are found in Appendix A.

5.3 Scenario results

A total of four policy scenarios were examined using the WMPM:

- Ontario's waste reduction action plan scenario which includes those measures announced by the Minister of the Environment that will be implemented to assist the Province in achieving the 50 per cent waste diversion target (Ministry of the Environment 1991).

- economic measures scenario which includes only measures which result in economic or market based incentives;

- regulatory measures scenario which includes only measures which result in actions required by law;

- selected combination of economic and regulatory measures scenario which includes economic incentives and regulation; and

The regulatory measures scenario and the selected combination of economic and regulatory measures scenario are the WRAP scenario plus some additional measures. The four scenarios included in the report indicate the impact different policy instruments have in achieving Ontario's waste diversion targets. These four scenarios do not represent the full range of possible options available for achieving the waste diversion targets using the WMPM.

The WMPM estimates the amount of waste sent to disposal and the amount of waste diverted (through reduction, reuse and recycling), the cost of implementing each scenario and the effect of the scenario on the total costs of waste management. The total costs of waste management equal the costs of waste management plus incremental program costs.

Sensitivity analysis was not conducted on the WMPM. The WMPM is a linear model. Small changes in the model's parameters would result in corresponding small changes in the results of the model. Users of the WMPM can conduct limited sensitivity analysis through the *Policy Ranks*, *Factors*, *Efficiencies* and *Formulae* options in the OPTIONS sub-program.

5.3.1 Ontario's waste reduction action plan

The following measures were included in the Waste Reduction Action Plan (WRAP) scenario:

- Mandatory source separation
- Industrial waste audits
- Yard and organic waste collection programs
- Education programs
- Expanded blue box programs

Measures are ranked in order of presentation and operate at 100 per cent efficiency. The measures are assumed partial complements: the portion of waste type diverted by previously implemented measures reduces the portion of a waste type diverted by the subsequent complementary measure. For example, if measure 1 diverts 25 per cent of waste type A and measure 2 diverts 20 per cent of waste type A, then the effectiveness of both measures on waste type A is, 25 per cent diverted by measure 1 and 15 per cent diverted by measure 2 ((1-0.25) times 0.20), for a total diversion of waste type A of 40 per cent, assuming no diversion of waste type A occurred prior to the implementation of either measure.

Figure 4 presents the total waste disposal and diversion from 1987 to 2000 for the Ontario WRAP scenario. This scenario is based on the actions announced by the Minister of the Environment in April, 1991. In 1992 the WRAP will increase waste diversion by 11 per cent over the current trend forecast resulting in approximately 25 per cent of total waste generation being diverted. In 2000, waste diversion will increase by 13 per cent over the current trend resulting in 36 per cent of all waste generation being diverted. The WRAP is not expected to achieve the 2000 provincial waste diversion targets.

Table 19 and Table 20 present the total waste diverted by waste type achieved by the scenario.

The WRAP results in a savings of total waste management costs (including incremental program costs) of $21 million (1989$) in 1992 and $36 million (1989$) in 2000. The increase in costs arising from this scenario can be attributed to the inclusion of: yard and organic waste collection programs; and expanded *blue box* programs.

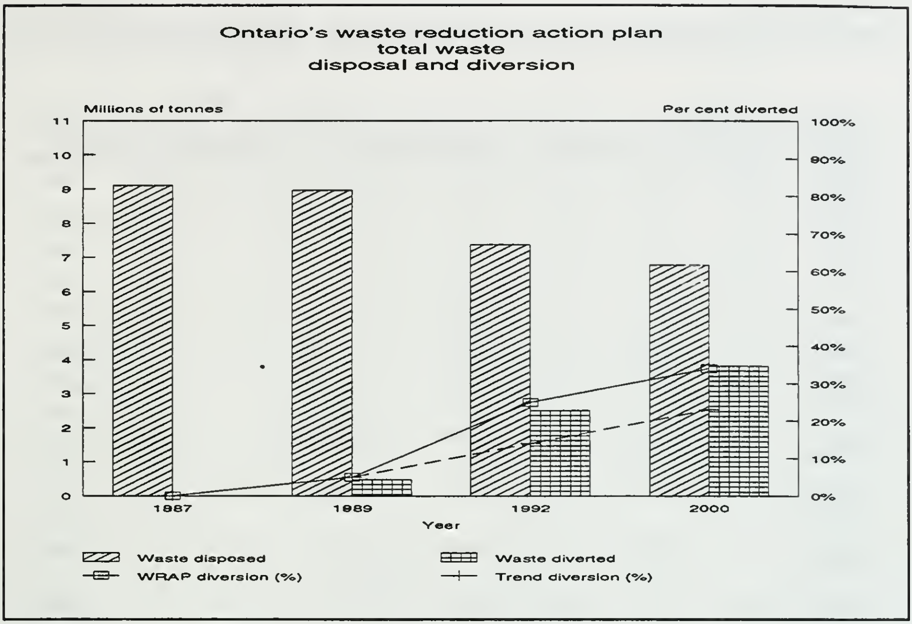

Figure 4
Ontario's waste reduction action plan total waste disposal and waste diversion

A detailed description of the measures included and the results of the Ontario WRAP is found in Appendix A and Appendix C.

5.3.2 Economic measures

The following measures were included in the economic measures scenario:

- Deposit systems
- Subsidies to producers
- Increase municipal funding
- Landfill tipping fees
- Subsidized home composters

Table 19
Ontario waste reduction action plan incremental residential waste diversion by waste type

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%	0%	77%	15%	8%	0%	88%	5%
Fine Paper	0%	0%	36%	64%	0%	0%	63%	37%
Boxboard	0%	0%	28%	72%	0%	0%	60%	40%
OCC	0%	0%	20%	80%	0%	0%	37%	63%
Mixed Paper	0%	0%	0%	100%	0%	0%	0%	100%
Magazines	0%	0%	20%	80%	0%	0%	41%	59%
Telephone Books	9%	0%	17%	74%	9%	0%	43%	48%
Glass Containers	1%	0%	42%	57%	2%	0%	57%	41%
Plastic (rigid and film)	-14%	0%	22%	92%	-74%	0%	80%	94%
Composite Packaging	0%	0%	0%	100%	0%	0%	0%	100%
Aluminium Cans, Foil	30%	0%	38%	31%	34%	0%	44%	22%
Tinplate, Steel Cans	-26%	0%	85%	41%	-16%	0%	90%	26%
White Goods	0%	0%	0%	100%	0%	0%	0%	100%
Used Tires	0%	2%	0%	98%	0%	2%	0%	98%
Yard Waste	2%	0%	44%	54%	5%	0%	81%	14%
Food Waste	24%	0%	2%	74%	32%	0%	7%	61%
Wood Waste	0%	0%	0%	100%	0%	0%	0%	100%
Construction /Demolition Waste	0%	0%	0%	100%	0%	0%	0%	100%
Disposable Diapers	27%	0%	0%	73%	31%	0%	0%	69%
Foundry Sands	0%	0%	0%	100%	0%	0%	0%	100%
Asphalt	0%	0%	0%	100%	0%	0%	0%	100%
Other	6%	0%	0%	94%	4%	0%	0%	96%

Source: Appendix C.

Table 20
Ontario waste reduction action plan incremental IC&I waste diversion by waste type

	1992				2000			
IC&I	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%	0%	42%	50%	5%	0%	49%	46%
Fine Paper	11%	0%	27%	62%	29%	0%	37%	34%
Boxboard	1%	0%	13%	87%	-2%	0%	24%	77%
OCC	1%	0%	49%	50%	-2%	0%	66%	35%
Mixed Paper	0%	0%	19%	81%	-2%	0%	18%	84%
Magazines	1%	0%	5%	94%	-1%	0%	10%	91%
Telephone Books	9%	0%	9%	82%	9%	0%	16%	75%
Glass Containers	2%	0%	27%	71%	0%	0%	30%	70%
Plastic (rigid and film)	-14%	0%	24%	91%	-77%	0%	68%	109%
Composite Packaging	0%	0%	0%	100%	0%	0%	0%	100%
Aluminium Cans, Foil	22%	0%	40%	37%	26%	0%	42%	32%
Tinplate, Steel Cans	-57%	0%	52%	105%	-48%	0%	60%	88%
White Goods	0%	0%	0%	100%	0%	0%	0%	100%
Used Tires	0%	0%	24%	76%	-2%	0%	66%	36%
Yard Waste	2%	0%	12%	87%	-1%	0%	28%	73%
Food Waste	1%	0%	29%	70%	-2%	0%	47%	55%
Wood Waste	1%	0%	24%	75%	-2%	0%	35%	67%
Construction /Demolition Waste	34%	0%	25%	41%	42%	0%	37%	22%
Disposable Diapers	19%	0%	0%	81%	19%	0%	0%	81%
Foundry Sands	5%	0%	1%	94%	10%	0%	27%	62%
Asphalt	0%	0%	0%	100%	0%	0%	0%	100%
Other	15%	0%	0%	85%	14%	0%	0%	86%

Source: Appendix C.

- Packaging taxes
- User charges
- Virgin materials taxes

Measures are ranked in order of presentation and operate at 100 per cent efficiency. The measures are assumed partial complements: the portion of a waste type diverted by previously implemented measures reduces the portion of a waste type diverted by the subsequent complementary measure, (for example, see page 73).

Figure 5 presents the total waste disposed and diverted and the total per cent of waste diverted from 1987 to 2000 for the economic measures scenario. In 1992, waste diversion will increase by 11 per cent to a total of 25 per cent of all waste generated. In 2000, the economic measures scenario will divert just over 14 per cent more of total waste generated than expected from the current trend forecast resulting in 37 per cent of all waste generation being diverted. The economic scenario does not achieve the 2000 provincial waste diversion targets.

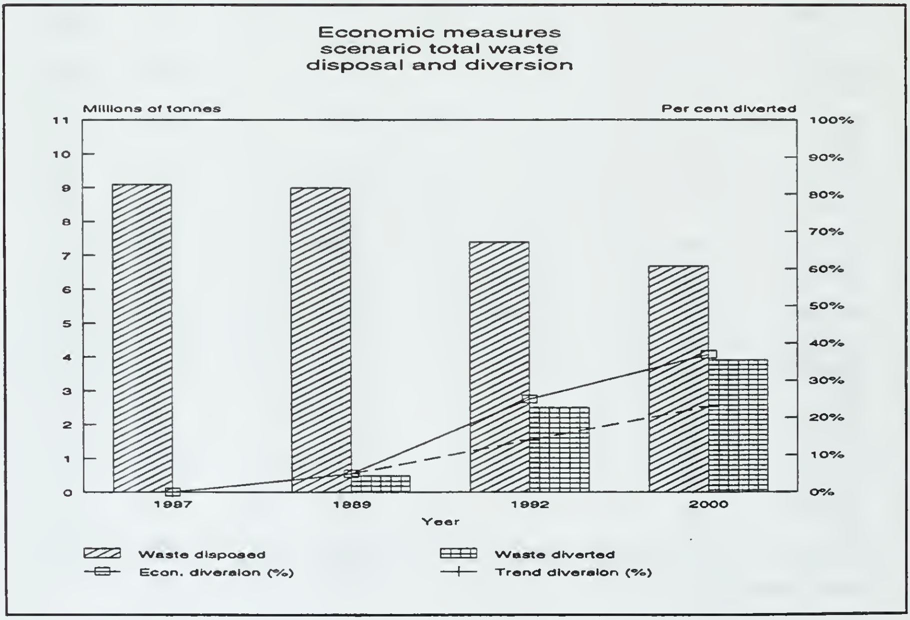

Figure 5
Economic measures scenario total waste disposal and waste diversion

Table 21 and Table 22 present the total waste diverted by waste type achieved by the scenario.

The economic measures scenario results in a saving of total waste management costs (including incremental program costs) of $2 million (1989$) in 1992 and, in 2000, $5 million (1989$). The net reduction in waste management costs accrue primarily to waste generators. The province and municipalities do not have to spend significant amounts of money to achieve these measures.

A detailed description of the measures included and the results of the economic measures scenario are found in Appendix A and Appendix C.

5.3.3 Regulatory measures

The following measures were included in the regulatory measures scenario:

- Education programs
- Landfill bans
- Yard and organic waste collection programs
- Industrial waste audits
- Mandatory processing of solid waste collected
- Expanded blue box programs
- Mandatory source separation
- Recycled content regulation

Measures are ranked in order of presentation and operate at 100 per cent efficiency. The regulatory measures scenario is the WRAP scenario plus the following measures: landfill bans; mandatory processing of solid waste collected; and recycled content regulation. The measures are assumed partial complements: the portion of a waste type diverted by previously implemented measures reduces the portion of a waste type diverted by the subsequent complementary measure, (for example, see page 73).

Figure 6 presents the total waste disposal and diversion from 1987 to 2000 for the regulatory measures scenario. In 1992, waste diversion increases by 19 per cent to a total

Table 21
Economic measures scenario incremental residential waste diversion by waste type

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%	0%	78%	14%	8%	0%	88%	5%
Fine Paper	0%	0%	34%	66%	0%	0%	59%	41%
Boxboard	0%	0%	35%	65%	0%	0%	64%	36%
OCC	0%	0%	40%	60%	0%	0%	68%	32%
Mixed Paper	0%	0%	0%	100%	0%	0%	0%	100%
Magazines	0%	0%	16%	84%	0%	0%	37%	63%
Telephone Books	9%	0%	17%	74%	9%	0%	46%	45%
Glass Containers	1%	0%	63%	35%	2%	0%	74%	24%
Plastic (rigid and film)	-14%	0%	22%	92%	-74%	0%	80%	93%
Composite Packaging	11%	0%	7%	82%	21%	0%	10%	69%
Aluminium Cans, Foil	30%	0%	55%	15%	34%	0%	53%	13%
Tinplate, Steel Cans	-26%	0%	97%	30%	-16%	0%	98%	18%
White Goods	0%	0%	0%	100%	0%	0%	0%	100%
Used Tires	0%	0%	22%	78%	0%	0%	14%	86%
Yard Waste	25%	0%	21%	54%	27%	0%	57%	16%
Food Waste	19%	0%	2%	78%	32%	0%	7%	61%
Wood Waste	0%	0%	0%	100%	0%	0%	0%	100%
Construction /Demolition Waste	0%	0%	0%	100%	0%	0%	0%	100%
Disposable Diapers	30%	0%	0%	70%	43%	0%	0%	57%
Foundry Sands	0%	0%	0%	100%	0%	0%	0%	100%
Asphalt	0%	0%	0%	100%	0%	0%	0%	100%
Other	5%	0%	0%	95%	5%	0%	0%	95%

Source: Appendix C.

Table 22
Economic measures scenario incremental IC&I waste diversion by waste type

	1992				2000			
IC&I	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%	0%	43%	49%	5%	0%	48%	47%
Fine Paper	11%	0%	24%	65%	29%	0%	35%	36%
Boxboard	1%	0%	10%	89%	-2%	0%	15%	86%
OCC	1%	0%	60%	39%	-2%	0%	79%	22%
Mixed Paper	0%	0%	19%	81%	-2%	0%	18%	84%
Magazines	1%	0%	0%	99%	-1%	0%	0%	101%
Telephone Books	9%	0%	8%	83%	9%	0%	17%	73%
Glass Containers	2%	0%	45%	53%	0%	0%	60%	40%
Plastic (rigid and film)	-14%	0%	20%	94%	-77%	0%	63%	114%
Composite Packaging	8%	0%	5%	87%	15%	0%	7%	78%
Aluminium Cans, Foil	22%	0%	45%	32%	26%	0%	50%	24%
Tinplate, Steel Cans	-57%	0%	60%	97%	-48%	0%	76%	72%
White Goods	0%	0%	0%	100%	0%	0%	0%	100%
Used Tires	0%	0%	35%	65%	-2%	0%	68%	34%
Yard Waste	11%	0%	0%	89%	19%	0%	0%	81%
Food Waste	13%	0%	18%	69%	24%	0%	29%	47%
Wood Waste	1%	0%	21%	78%	-2%	0%	33%	69%
Construction/ Demolition Waste	34%	0%	27%	40%	42%	0%	38%	20%
Disposable Diapers	23%	0%	0%	77%	27%	0%	0%	73%
Foundry Sands	7%	0%	1%	92%	15%	0%	27%	58%
Asphalt	0%	0%	0%	100%	0%	0%	0%	100%
Other	5%	0%	0%	95%	5%	0%	0%	95%

Source: Appendix C.

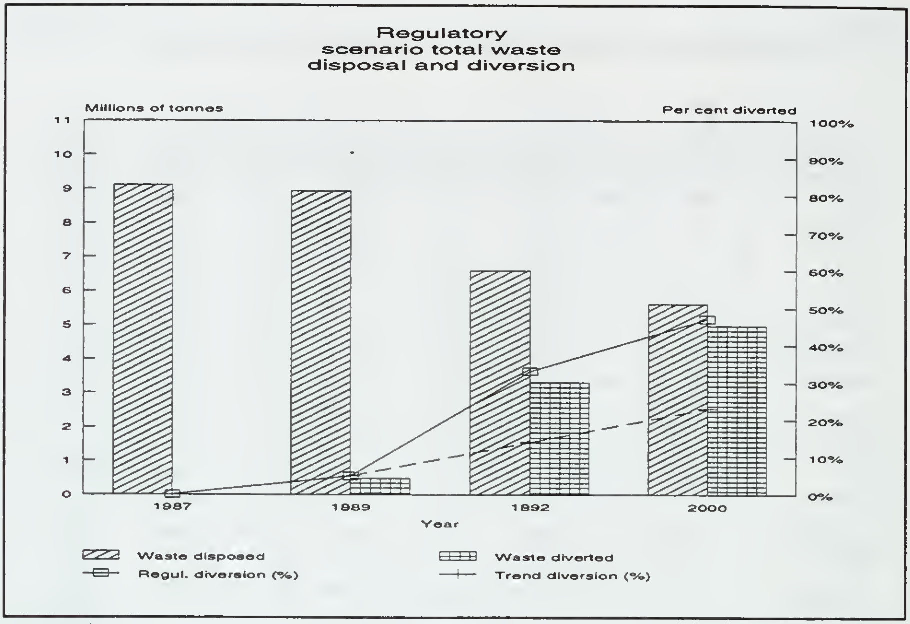

Figure 6
Regulatory measures scenario total waste disposal and waste diversion

of 33 per cent of all waste generated, exceeding the 1992 provincial waste diversion target. In 2000 24 per cent more waste than the current trend forecast will be diverted, resulting in a total of 47 per cent of all waste being diverted.

Table 23 and Table 24 present the total waste diverted by waste type achieved by the scenario.

The regulatory measures scenario results in a saving of total waste management costs (including incremental program costs) of $60 million (1989$) in 1992 and $105 million (1989$) in 2000. The increase in costs arising from this scenario can be attributed to the inclusion of several costly measures: mandatory processing of solid waste collected; yard and organic waste collection programs; and expanded *blue box* programs.

A detailed description of the measures included and the results of the regulatory measures scenario are found in Appendix A and Appendix C.

Table 23
Regulatory measures scenario incremental residential waste diversion by waste type

	1992				2000			
Residential	**Reduction**	**Reuse**	**Recycle**	**Landfill**	**Reduction**	**Reuse**	**Recycle**	**Landfill**
ONP	8%	0%	81%	11%	8%	0%	89%	3%
Fine Paper	0%	0%	50%	50%	0%	0%	76%	24%
Boxboard	0%	0%	34%	66%	0%	0%	68%	32%
OCC	0%	0%	51%	49%	0%	0%	79%	21%
Mixed Paper	0%	0%	0%	100%	0%	0%	0%	100%
Magazines	0%	0%	26%	74%	0%	0%	48%	52%
Telephone Books	9%	0%	21%	70%	9%	0%	46%	45%
Glass Containers	1%	0%	31%	68%	2%	0%	46%	52%
Plastic (rigid and film)	-14%	0%	26%	88%	-74%	0%	93%	80%
Composite Packaging	0%	0%	0%	100%	0%	0%	0%	100%
Aluminium Cans, Foil	30%	0%	28%	42%	34%	0%	35%	31%
Tinplate, Steel Cans	-26%	0%	74%	52%	-16%	0%	82%	34%
White Goods	0%	0%	0%	100%	0%	0%	0%	100%
Used Tires	0%	0%	10%	90%	0%	0%	15%	85%
Yard Waste	2%	0%	64%	33%	5%	0%	88%	7%
Food Waste	24%	0%	2%	74%	32%	0%	7%	61%
Wood Waste	0%	0%	20%	80%	0%	0%	30%	70%
Construction /Demolition Waste	0%	0%	0%	100%	0%	0%	0%	100%
Disposable Diapers	31%	0%	0%	69%	42%	0%	0%	58%
Foundry Sands	0%	0%	0%	100%	0%	0%	0%	100%
Asphalt	0%	0%	0%	100%	0%	0%	0%	100%
Other	6%	0%	0%	94%	5%	0%	0%	95%

Source: Appendix C.

Table 24
Regulatory measures scenario incremental IC&I waste diversion by waste type

	1992				2000			
IC&I	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%	0%	55%	37%	5%	0%	69%	26%
Fine Paper	11%	0%	39%	50%	29%	0%	48%	23%
Boxboard	1%	0%	17%	82%	-2%	0%	31%	71%
OCC	1%	0%	71%	28%	-2%	0%	86%	16%
Mixed Paper	0%	0%	19%	81%	-2%	0%	18%	84%
Magazines	1%	0%	5%	94%	-1%	0%	10%	91%
Telephone Books	9%	0%	9%	82%	9%	0%	16%	75%
Glass Containers	2%	0%	21%	77%	0%	0%	20%	80%
Plastic (rigid and film)	-14%	0%	29%	85%	-77%	0%	76%	101%
Composite Packaging	0%	0%	0%	100%	0%	0%	0%	100%
Aluminium Cans, Foil	22%	0%	47%	31%	26%	0%	50%	24%
Tinplate, Steel Cans	-57%	0%	62%	94%	-48%	0%	74%	74%
White Goods	0%	0%	0%	100%	0%	0%	0%	100%
Used Tires	0%	0%	28%	72%	-2%	0%	69%	33%
Yard Waste	2%	0%	27%	72%	-1%	0%	48%	53%
Food Waste	1%	0%	38%	61%	-2%	0%	62%	40%
Wood Waste	1%	0%	43%	56%	-2%	0%	54%	48%
Construction /Demolition Waste	34%	0%	31%	35%	42%	0%	41%	17%
Disposable Diapers	28%	0%	0%	72%	36%	0%	0%	64%
Foundry Sands	5%	0%	4%	90%	10%	0%	30%	59%
Asphalt	0%	0%	0%	100%	0%	0%	0%	100%
Other	19%	0%	0%	81%	19%	0%	0%	81%

Source: Appendix C.

5.3.4 Selected combination of economic and regulatory measures

The following measures were included in the selected combination of economic and regulatory measures scenario:

- Education programs
- Yard and organic waste collection programs
- Landfill bans
- Mandatory source separation
- Expanded blue box programs
- Virgin materials taxes
- Industrial waste audits
- User charges

The selected combination of economic and regulatory measures scenario is the WRAP scenario plus the following measures: landfill bans; virgin materials taxes; and user charges. Measures are ranked in order of presentation and operate at 100 per cent efficiency. The measures are assumed partial complements: the portion of a waste type diverted by previously implemented measures reduces the portion of a waste type diverted by the subsequent complementary measure, (for example, see page 73).

Figure 7 presents the total waste disposal and diversion from 1987 to 2000 for the selected combination of economic and regulatory measures scenario. In 1992, waste diversion increases by over 23 per cent to a total of 37 per cent of all waste generated, exceeding the 1992 provincial waste diversion target. In 2000, 25 per cent more waste than the current trend forecast will be diverted, resulting in a total of 48 per cent of all waste being diverted.

Table 25 and Table 26 present the total waste diverted by waste type achieved by the scenario.

The selected combination of economic and regulatory measures scenario results in a saving of total waste management costs (including incremental program costs) of $42 million (1989$) in 1992 and $46 million (1989$) in 2000. The increase in costs reflects the inclusion of yard and organic waste collection programs and expanded *blue box* programs in the scenario.

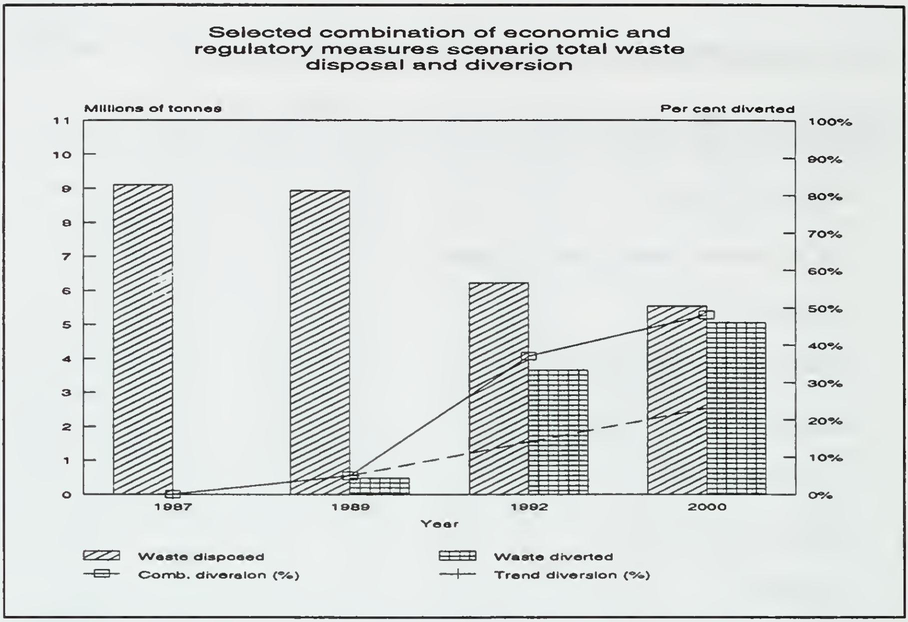

Figure 7
Selected combination of economic and regulatory measures scenario total waste disposal and waste diversion

A detailed description of the measures included and the results of the selected combination of economic and regulatory measures scenario is found in Appendix A and Appendix C.

5.4 Summary results

Table 17 presents a summary of the waste diversion potential and waste management costs resulting from the current trend and the four waste diversion policy scenarios.

- The current trend scenario result indicates that 14 per cent of waste will be diverted from landfill in 1992 and 23 per cent in 2000. The total cost of solid waste management is $843 million in 1992 and $947 million in 2000.

- The individual measures resulting in the largest diversion of waste from landfill, which are: landfill bans, mandatory source separation, landfill tipping fees and user charges also result in net savings in waste total waste management costs. The

Table 25
Selected combination of economic and regulatory measures scenario incremental residential waste diversion by waste type

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%	0%	82%	10%	8%	0%	90%	3%
Fine Paper	0%	0%	47%	53%	0%	0%	72%	28%
Boxboard	0%	0%	36%	64%	0%	0%	69%	31%
OCC	0%	0%	57%	43%	0%	0%	88%	12%
Mixed Paper	0%	0%	0%	100%	0%	0%	0%	100%
Magazines	0%	0%	26%	74%	0%	0%	48%	52%
Telephone Books	9%	0%	21%	70%	9%	0%	46%	45%
Glass Containers	1%	0%	58%	40%	2%	0%	70%	29%
Plastic (rigid and film)	-14%	0%	32%	81%	-74%	0%	100%	74%
Composite Packaging	0%	0%	0%	100%	0%	0%	0%	100%
Aluminium Cans, Foil	30%	0%	53%	17%	34%	0%	54%	12%
Tinplate, Steel Cans	-26%	0%	103%	24%	-16%	0%	102%	14%
White Goods	0%	0%	0%	100%	0%	0%	0%	100%
Used Tires	0%	0%	10%	90%	0%	0%	15%	85%
Yard Waste	2%	0%	74%	23%	5%	0%	92%	3%
Food Waste	34%	0%	2%	64%	45%	0%	7%	48%
Wood Waste	0%	0%	20%	80%	0%	0%	30%	70%
Construction /Demolition Waste	0%	0%	0%	100%	0%	0%	0%	100%
Disposable Diapers	44%	0%	0%	56%	61%	0%	0%	39%
Foundry Sands	0%	0%	0%	100%	0%	0%	0%	100%
Asphalt	0%	0%	0%	100%	0%	0%	0%	100%
Other	11%	0%	0%	89%	9%	0%	0%	91%

Source: Appendix C.

Table 26

Selected combination of economic and regulatory measures scenario incremental IC&I waste diversion by waste type

	1992				2000			
IC&I	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%	0%	52%	41%	5%	0%	62%	33%
Fine Paper	11%	0%	46%	43%	29%	0%	55%	16%
Boxboard	1%	0%	25%	74%	-2%	0%	41%	60%
OCC	1%	0%	71%	28%	-2%	0%	87%	15%
Mixed Paper	0%	0%	19%	81%	-2%	0%	18%	84%
Magazines	1%	0%	5%	94%	-1%	0%	10%	91%
Telephone Books	9%	0%	9%	82%	9%	0%	16%	75%
Glass Containers	2%	0%	39%	58%	0%	0%	41%	59%
Plastic (rigid and film)	-14%	0%	29%	85%	-77%	0%	76%	101%
Composite Packaging	0%	0%	0%	100%	0%	0%	0%	100%
Aluminium Cans, Foil	22%	0%	49%	28%	26%	0%	56%	18%
Tinplate, Steel Cans	-57%	0%	61%	95%	-48%	0%	73%	75%
White Goods	0%	0%	0%	100%	0%	0%	0%	100%
Used Tires	0%	0%	28%	72%	-2%	0%	69%	33%
Yard Waste	2%	0%	27%	72%	-1%	0%	48%	53%
Food Waste	1%	0%	47%	52%	-2%	0%	76%	26%
Wood Waste	1%	0%	43%	56%	-2%	0%	54%	48%
Construction/ Demolition Waste	34%	0%	31%	35%	42%	0%	41%	17%
Disposable Diapers	28%	0%	0%	72%	36%	0%	0%	64%
Foundry Sands	5%	0%	4%	90%	10%	0%	30%	59%
Asphalt	0%	0%	0%	100%	0%	0%	0%	100%
Other	20%	0%	0%	80%	19%	0%	0%	81%

Source: Appendix C.

effectiveness of these measures is the result of their ability to divert large portions of waste types which contribute significantly to the total waste management stream.

- The individual measures resulting in an increase in the total costs of waste management are; expanded *blue box* programs, increased funding to municipalities for waste recycling and source reduction programs, mandatory processing of solid waste collected and yard and organic waste collection programs.

- The regulatory measures and the selected combination of economic and regulatory measures scenarios exceed the 1992 waste diversion target. The incremental cost of achieving the 1992 target using regulatory measures is about $60 million (1989$) while the incremental cost of achieving the target using a selected combination of economic and regulatory measures is less, $42 million (1989$).

- The economic measures and the WRAP both achieved the 1992 waste diversion target most effectively. The economic measures scenario incurs the least in incremental costs, $2 million (1989$), while the WRAP scenario adds $21 million (1989$).

- The regulatory measures and the selected combination of economic and regulatory measures scenario almost achieve the 2000 waste diversion target. The incremental cost of achieving the 2000 target is $105 million under the regulatory measures scenario and $46 million (1989$) under the selected combination of economic and regulatory measures scenario. The regulatory measures scenario is the most costly for achieving the 2000 waste diversion target.

- The decrease in cost from 1992 to 2000 for the selected combination of economic and regulatory measures scenario results from the greater input of low cost measures in the longer term and that the inclusion of economic measures lowers the direct cost of achieving the waste management diversion target by having the cost of some of the measures assumed by waste generators.

- Neither the economic measures nor the WRAP will achieve the 2000 waste diversion target.

- To achieve the 2000 target of a 50 per cent diversion of waste, the category of *other* wastes are assumed affected by various policy measures. *Other* wastes constitute 25 per cent of residential and 19 percent of IC&I in 2000.

- All four waste diversion policy scenarios contribute only marginally to the total costs of waste management. The economic measures scenario reduces waste management costs by only $5 million in 2000 (less than one per cent of total waste management costs). The regulatory measures scenario results in the greatest increase in total waste management costs, $105 million, increasing waste management costs by 11 per cent

by 2000. This amounts to less than a one per cent per annum real increase in the cost of waste management between 1989 and 2000.

6 The macroeconomic impacts model

6.1 Introduction

Macroeconomic models are generally based on a particular national income accounting framework. The current Canadian accounting framework treats waste and pollution generation such that any increase in these activities increases directly GDP. Thus, a society can increase its GDP by simply increasing the waste it produces. This follows from the fact that garbage collection, pollution abatement and sewage treatment activities appear as part of the final demand of the economy. Garbage collection and sewage treatment are part of the municipal government sector and this sector, like all other government activity, is treated as if it produces final output. Common sense suggests that no society should be considered richer or better off if it were to produce more waste. Since the current GDP measure does exactly this, it is sensible to re-examine the GDP concept and the way it is measured.

In this study a suggested reformulation of the accounting framework is presented that treats waste management and pollution abatement as services to business whose costs should be charged against business revenues. Even such services to households may be considered as costs of output to the extent that part of household activity may be incorporated within the business sector. In this way they appear as a cost to society and not as final output.

The major contribution of the study, however, is the new theoretical framework developed and expanded to correspond to the new reformulated accounting framework. Within this new framework it is possible to identify clearly and carefully the recycling activity and the operations of waste management (Figure 8) within the general operations of the economy. It is also possible to outline the socioeconomic consequences and impacts that emerge from adopting alternative waste reduction and diversion strategies.

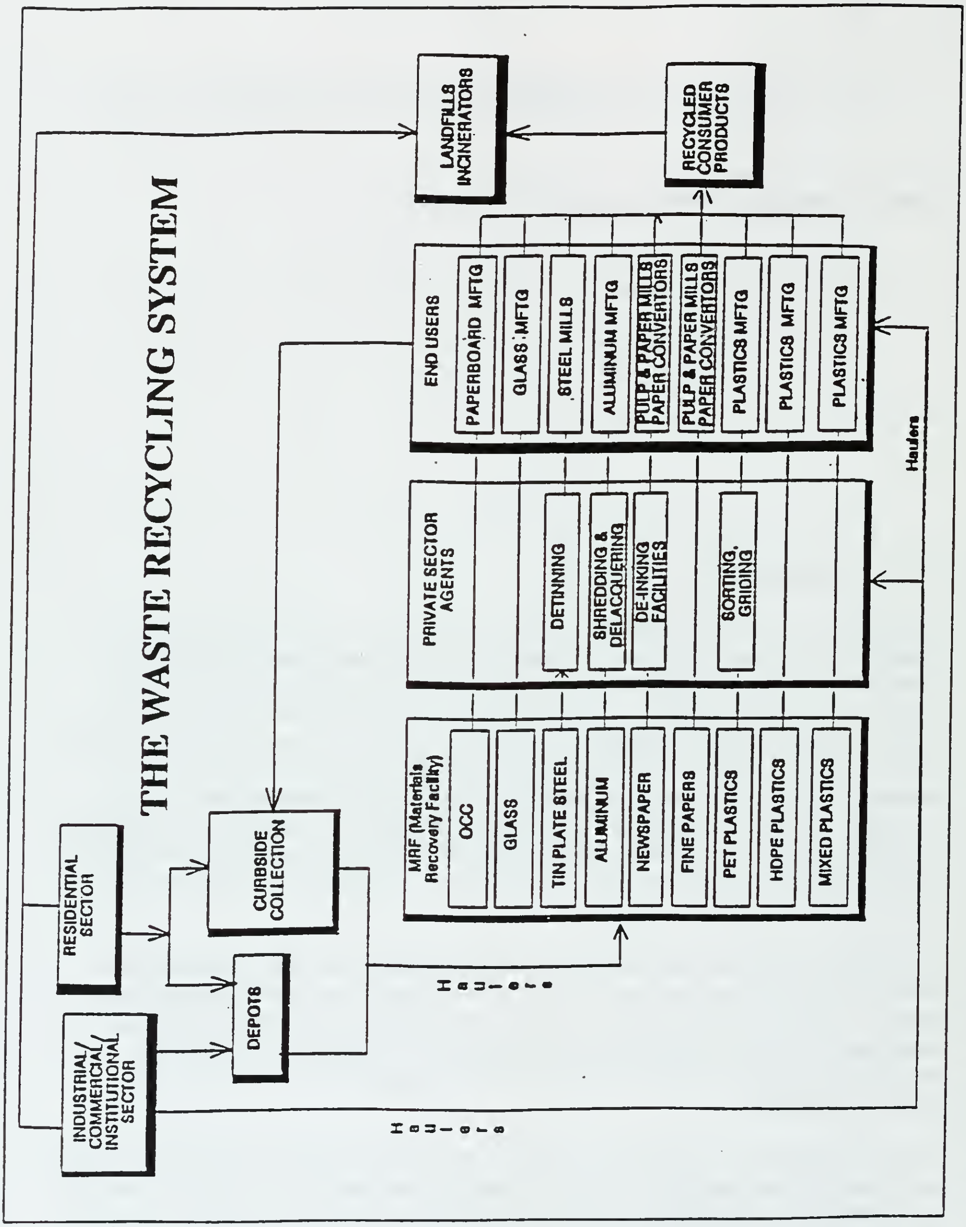

Figure 8
The waste management system

The rectangular input-output framework used by Statistics Canada to present the interprovincial tables is particularly suited for introducing environmental and waste management activities as it allows different industries to produce the same output, and identifies different commodities as inputs in the production of the same output. In this way, paper can be made from virgin pulp or from recycled paper. The two industries use different technologies but produce the same output. Several new commodities are also introduced into the system. These include recyclable (waste) and recycled (substitutes for virgin products) commodities. What in the past was waste and disposed of, is now a new input into the production of consumer products. Recyclable materials are produced primarily but not exclusively by households and institutions, and are used by industry to produce products that are almost indistinguishable from products made from virgin fibre.

The new framework adopted here extends our ability to deal with environmental and waste management issues that are difficult or impossible to deal with within the old framework. Different scenarios of waste management policies can be analyzed within this framework determining the feasibility and consistency of reducing, reusing and recycling strategies as well as their economic, environmental and social consequences within a general equilibrium framework capable of specifying quantities and prices that will ensure balance in the system.

The outputs of the WMPM act as inputs into the macroeconomic model. Two basic outputs of the WMPM are particularly useful for the macroeconomic analysis:

- proportion of waste, by waste type, that is actually recycled, which is used directly in the input/output model to recalculate the inverse (multiplier) matrix; and,

- costs of the waste diversion scenarios, and how these costs are distributed between the economic sectors (residential, IC&I, recycling and waste management) and the public sector.

The costs of the waste diversion scenarios enter as expenditures on the supply side and as reductions in consumption (households), investment (business) and other expenditures (government) on the demand side of the macroeconomic model.

In this study, an attempt is made to gauge the economic and social consequences using a set of indicators including income, output, labour income, employment, taxes collected by type of tax and the level of government, by sector and region at the provincial level. The model is solved at the provincial level for all macroeconomic variables. The impact indicators generated above can also be used to identify sectors, industries and regions that may be adversely affected by the waste reduction policies and regulations. These impacts are distributed to counties in a particular region of the province using historical economic base share coefficients. Of particular interest here are the operating performance indices that can be generated by the model.

These include industry specific operating surplus indices per unit of output or, if capital data are available, operating surplus per unit of invested capital as well as region specific indicators that could tally the employment effects in terms of a bench mark employment totals. Equally important is the system's ability to assess the relative efficiency of alternative policies to reuse or reduce the use of products and resources through price incentives and full cost charges.

A glossary of terms used for defining the output of the model is provided in Appendix D.

6.2 The model

Recycling, reusing and other waste management activities involve the use of scarce resources and the generation of outputs and services. Typically, these activities were either neglected, mis-allocated or subsumed within other activities of other sectors within the standard input output accounting framework. Any attempt to focus on these activities calls for a major reformulation of the standard accounting framework. The adjustment process involves not only broadening the Use (input), Make (output) and Final Demand matrices of the rectangular input-output framework to encompass new commodities and industries, but also redefining the entire accounting relationships governing the system.

Three basic matrices define the structure of the traditional system: a "Make" (output) matrix, a "Use" (input) matrix, and a "Final Demand" matrix. The new adjusted system starts with these typical matrices. Adjustments and changes are made to each one in a manner that preserves consistency across all the component parts. A more detailed description of these matrices and the accounting relationships is presented in Appendix D.

6.2.1 The adjusted Use matrix

The Use matrix represents the value of a commodity (primary input) used in production by an industry. The usual categories of primary inputs include: non-competitive imports, indirect taxes, labour income including benefits, net income of unincorporated business and other operating surplus.

Introducing the waste management activities explicitly into the overall production framework results in two basic changes to the structure of the Use matrix. First, many new producible inputs will be added to the matrix. These are the recyclable products, and services provided by the waste management and environmental protection industries (EPI). The adjusted Use matrix is expanded and dis-aggregated to show explicitly scrap, recyclable materials, recycled products and waste treatment and disposal services. Second,

the primary input matrix is expanded and reorganized to included the use of renewable and non-renewable resources extracted directly from the environment.

6.2.2 The adjusted Make matrix

The Make (output) matrix is the value of the commodity produced by an industry. Thus each industry may, and typically does, produce more than one commodity. The incorporation of waste management activities requires the reformulation of the traditional Make matrix in a way that allows the production of recyclable materials and the management of waste. The changes that follow from this are summarized below.

6.2.3 The adjusted Final Demand matrix

The final demand matrix defines the deliveries of commodities to consumption, investment, government expenditures, exports to other provinces, and exports to the rest of the world.

Several adjustments to the Final Demand matrix are required to introduce the waste management - environmental linkages. First, households, institutions and government both generate recyclable materials in their waste and use recyclable products and their activities and choices influence the operations and activity levels of producers. Second, business investment is allowed to create capacity for the future production of recyclable products. The environmental perspective is typically long term and the system is made dynamical by linking business investment to output increases.

A major departure from the traditional input-output system is the inclusion of the final demand sectors into both the Make matrix and the Use matrix since i) households and institutions, as well as industries, produce waste and ii) recycled material and recyclable waste are distinguished from other commodities. A prominent role is also given to waste management services and environmental protection industries in the adjusted accounting framework.

The changes introduced above alter way the various accounting relationships governing the system. A full representation of these accounting relationships is provided in Appendix D.

6.3 Hypotheses and assumptions of the model

In order to go from an input/output accounting framework to a model of the economy it is necessary to make a number of simplifying assumptions. Traditionally, the most restrictive assumptions are in the area of fixed market shares and fixed input coefficients. Although the simplicity with which a linear input/output model operates can compensate for the limited flexibility of the model resulting from the use of fixed input coefficients, this is not always the case. For this project allowance for some substitution among technologies for pulp and newsprint production is made to permit shifts from the use of virgin material to recycled materials in the production of pulp and newsprint in Ontario. Thus, the restrictiveness of the assumption of fixed input coefficients for pulp and newsprint production is less stringent than in many other applications of input-output analysis. The following description of the model starts with a simple system that is subsequently made more complex.

There is a logical order to the hypotheses of the model. Appendix D provides a full discussion of the Make matrix conditions, the hypotheses of the Use matrix and the Final Demand system.

The final demand system that is left outside the production system of the input/output model is driven by a large macro-econometric model. Final demand could equally be driven by forecasts available from other sources. This flexibility allows the user to simulate the consequences of several alternatives of rates of growth and policy options. There is no business cycle *per se* built into the model. If the exogenous macroeconomic forecasts used in this model display a cyclical pattern so will the results.

6.3.1 Implications of the modified model

A number of interesting characteristics are embedded within adjusted accounting framework that reveal the nature of the modifications suggested. First, the environmental protection industry (all waste management services including the collection, transportation, processing, and sorting of recyclable materials) is included in the adjusted Use matrix and the adjusted Make matrix as CSTP (environmental protection industries related to waste management). Second, a strong distinction is made between recyclable and recycled products. Recyclable products are gathered, sorted and delivered either to the primary industries or to the recycling industry. Third, recycled products are delivered as inputs to primary industries. Fourth, waste management services are allocated to businesses and to households. As such, waste management services delivered to businesses are allocated to intermediate demand (whereas in the standard input-output system waste management services are allocated entirely to final demand).

This reallocation of waste management services results in a reduction in the value of net output of the economy, since charges paid by businesses for waste management services reduces the businesses' operating surplus and therefore the value added assigned to them. In addition, these charges appear as revenues to the waste management sector, raising its value added. Thus, the net output of the economy is changed by moving a part of the deliveries of waste management services from final demand to intermediate demand and by redistributing the value added generated amongst activities within the waste management sector.

The primary features defining the modification's to the structure of production presented in the Use matrix can be summarised as follows:

- Recyclable materials are produced by all sectors other than the sorting and recycling industries.

- The paper industry produces paper from virgin materials and recycled materials.

- Recyclable materials are collected, sorted and transported by a special CSTP industry (environmental protection industries related to waste management) and are either delivered to recycling industries or to waste management industries (landfills).

- Households and governments are treated here as producing sectors of recyclable materials.

The extension and expansion of the Use matrix results in the following modifications of the Make matrix:

- Recyclable materials are produced by all sectors including some final demand sectors.

- Paper produced from virgin inputs is indistinguishable from paper produced from recycled paper. The model is flexible enough to allow price or specific measures that influence preferences and market shares.

- Waste management services are produced solely by the waste management industries.

- Recyclable materials are collected, sorted at CSTP and transported to recycling industries that produce the recycled products.

7 Results

Five scenarios were constructed to forecast and chart the future of waste management activities in the province. The year 1989 is taken as the reference year and all forecasts are generated in terms of 1989 prices.

The macroeconomic model is representative of the Ontario economy. The model considers commodity exports from Ontario to other countries and Provinces as exogenous. The model does not consider changes in commodity exports between different regions within Ontario. Exports are assumed equal to the historical trend allocated by commodity share. Also not included in the modelling are exports of waste out-of-province. The current recession is embedded into the forecasts of macroeconomic trends by using conservative forecasts of exogenous economic variables in the model.

The overall macroeconomic forecast was derived from the Conference Board of Canada's medium regional forecast; all the scenarios used in this study are simply variations on this forecast. The 1992 forecast adopts the weighted average quarterly forecasts made by the Conference Board. The forecasts for the year 2000 were developed by ERL. The 2000 forecast is based on the assumption that the implicit trends between 1981 and 1994 continue. Quarterly data in constant 1989 prices were used to extrapolate growth rates (i.e. from the first quarter of 1981 to the fourth quarter of 1994). These same growth rates were used to develop the macro-variables of the Ontario economy to the year 2000. The list of forecasted exogenous variables includes:

- consumption;
- government and business machinery investment;
- government and business construction investment;

- government expenditures on goods and services; and

- exports.

The commodity composition of all the macro-variables were generated using the 1984 provincial input output tables. The inverse of the input output system was then multiplied by the final demand components to generate the output, income and employment forecasts.

An additional scenario of a 25 per cent reduction in 1992 and a 50 per cent reduction in 2000 of pulp and newsprint exports was developed and included in the detailed sectoral and regional employment impact analysis. The rationale for including this scenario is as follows:

- Ontario's major export market for pulp and newsprint is the United States. Many U.S. states have or soon will be implementing similar recycling objectives to those already in Ontario.

- Many U.S. states have implemented or are planning to implement domestic recycled fibre content regulations.

- These two actions will reduce the historical levels of virgin pulp and newsprint exports from Ontario to the U.S. and limit the opportunity for Ontario to successfully develop a de-inking, recycled fibre pulp and newsprint industries to offset the impacts of reduced export demand for virgin pulp and newsprint and Ontario's own recycling programs.

The shift in the U.S. demand for Ontario pulp and newsprint could result in an adjustment (shift) in the Ontario economy greater than the distributional impacts of the waste diversion policy scenarios. The possibility and significance of such a result was considered for comparative purposes with the waste diversion policy scenarios developed for this study.

The important result of the macroeconomic modelling presented below is the distribution of economic impacts (shown through changes in regional employment) between regions. Equally important is the impact on industries not directly connected with the waste management sector (environmental protection industries related to waste management). Also of interest is the small cost households (decreased consumption), businesses (decreased investment) and governments (reduced tax revenue and incremental program costs) must incur to implement the waste diversion policy scenarios. As such, the macroeconomic impact of the four waste diversion policy scenarios is a reduction of less than one per cent of provincial gross output from the current trend forecast for 2000.

The macroeconomic analysis indicates that different industrial sector impacts emerge between the various waste diversion policy scenarios. In particular, the impact on the EPI (waste management sector) of the different scenarios is interesting with expenditures increasing through the use of a regulatory measures scenario and shrinking if economic measures are used. The analysis also indicates that the only other industrial sector to experience growth as a result of the waste diversion policy scenarios is the transportation sector.

The macroeconomic indicators/terms used in the analysis of the results of the model are as follows:

- **Gross (provincial) output**, is the total value of output of the economy which will be used for further processing in the economy.

- **Value added**, is a measure of net output which avoids double counting of products sold during the accounting period by including only final goods. For example, in final output, chairs are included, whereas the wood that goes into making them does not appear separately as a final output. Value added is equal to income (gross provincial income) and is calculated by adding together wages, interest, rent and profits. Alternatively, value added is equal to revenues minus the total cost of purchased inputs.

- **Labour income**, equals the total value of wage and salary payments to employees. Labour income is used as a measure of changes in household (consumer) expenditures.

- **Taxes**, are the direct and indirect income received by municipalities and the province from all sources.

- **Employment**, is the amount of labour time used in production, measured in person-years.

The first scenario is the current trend scenario where the future is profiled to maintain the same trends and practices in existence in 1989 and no basic changes are allowed in the policy framework or in the operating principles of the economy or in current waste management activities. The other four scenarios are as follows: Ontario's waste reduction action plan, economic measures scenario, regulatory measures scenario; and selected combination of economic and regulatory measures scenario. Details of each of these scenarios are found in Chapter 3 of the report.

The macroeconomic impacts of the scenarios on the Ontario economy in 1992 and 2000 are presented in Table 27. The reference year for all the scenarios is 1989 and all the results are expressed in 1989 dollars. The results of each scenario for the years 1992 and 2000 are presented below.

Like the WMPM, sensitivity analysis was not conducted on the macroeconomic impacts model. The impacts model is a linear model and small changes in the model's parameters would result in corresponding small changes in the model's results. However, the reduction in exports of pulp and newsprint scenario used for comparison with the waste diversion policy scenarios illustrates the sensitivity of certain regions and domestic industrial sectors to large shifts in export demand resulting from changes in domestic waste management policy.

Table 28 and Table 29 present the absolute and relative impact of each waste diversion scenario.

7.1 Current trend scenario

In 1992, the current trend has a gross output of $447 billion (1989$), resulting in 5.4 million person years of employment in Ontario. In 2000, the current trend gross output is expected to increase to $473 billion (1989$) with 5.7 million person years of employment. The current trend value added in 1992 is $311.3 billion and $341.1 billion in 2000. Labour income (consumer expenditures) in the current trend is $151.9 billion in 1992 and $171.7 billion in 2000. Current trend taxes rise from $50.3 billion in 1992 to $51.7 billion in 2000.

7.2 Ontario waste reduction action plan scenario

In 1992, the WRAP scenario results in a gross output of $440.4 billion (1989$), which is $6.1 billion or 1.4 per cent lower than the current trend in 1992. In 2000, GDP is forecast to increase to $470.4 billion (1989$) which is only $2.7 billion, 0.6 per cent, lower than the expected current trend. The value added decreases from the current trend in 1992 by $0.6 billion, or 0.2 per cent, and in 2000 by $0.4 billion from the current trend, or 0.1 per cent.

The resulting loss in labour income (consumer expenditures) arising from the WRAP scenario relative to the current trend is $1.2 billion (0.8 per cent of current trend labour income) in 1992 and $1.1 billion (0.6 per cent) in 2000. Government tax revenue (combined provincial and municipal) is expected to decrease by $ 0.2 billion, 0.4 per cent, in 1992 and $0.8 billion, 1.5 per cent, in 2000, relative to the current trend.

The WRAP scenario results in a decrease of 5,330 person years, or 0.1 per cent, of employment. In 2000, employment is expected to decrease 5,870 person years, or 0.1 per cent from the current trend total.

Table 27
Macroeconomic impacts of each scenario, 1992 and 2000

1992 Aggregate impacts (billions 1989$)

Scenario	Gross output	Value added	Labour income	Taxes	Employment (person years)
Current trend	$446.5	$311.3	$151.9	$50.3	5,389,564
Waste reduction action plan	$440.4	$310.7	$150.7	$50.1	5,384,236
Economic measures	$440.3	$310.7	$150.7	$50.1	5,384,207
Regulatory measures	$440.5	$310.8	$150.7	$50.1	5,384,264
Selected combination of economic and regulatory measures	$440.5	$310.8	$150.7	$50.1	5,384,257

2000 Aggregate impacts (billions 1989$)

Scenario	Gross output	Value added	Labour income	Taxes	Employment (person years)
Current trend	$473.1	$341.1	$171.7	$52.5	5,703,249
Waste reduction action plan	$470.4	$340.7	$170.6	$51.7	5,697,380
Economic measures	$470.2	$340.6	$170.6	$51.7	5,697,330
Regulatory measures	$470.6	$340.8	$170.7	$51.7	5,697,430
Selected combination of economic and regulatory measures	$470.5	$340.8	$170.6	$51.7	5,697,391

Table 28
Difference between waste diversion scenario and current trend, 1992 and 2000

Difference between waste diversion scenario and current trend, 1992 (billions 1989$)

Scenario	Gross output	Value added	Labour income	Taxes	Employment (person years)
Waste reduction action plan	($6.1)	($0.6)	($1.2)	($0.2)	(5,328)
Economic measures	($6.2)	($0.6)	($1.2)	($0.2)	(5,357)
Regulatory measures	($6.0)	($0.5)	($1.2)	($0.2)	(5,300)
Selected combination of economic and regulatory measures	($6.0)	($0.5)	($1.2)	($0.2)	(5,307)

Difference between waste diversion scenario and current trend, 2000 (billions 1989$)

Scenario	Gross output	Value added	Labour income	Taxes	Employment (person years)
Waste reduction action plan	($2.7)	($0.4)	($1.1)	($0.8)	(5,869)
Economic measures	($2.9)	($0.5)	($1.1)	($0.8)	(5,919)
Regulatory measures	($2.5)	($0.3)	($1.0)	($0.8)	(5,819)
Selected combination of economic and regulatory measures	($2.6)	($0.3)	($1.1)	($0.8)	(5,858)

Table 29
Change between waste diversion scenario and current trend, 1992 and 2000

Per cent change between waste diversion scenario and current trend, 1992

Scenario	Gross output	Value added	Labour income	Taxes	Employment (person years)
Waste reduction action plan	(1.4%)	(0.2%)	(0.8%)	(0.4%)	(0.1%)
Economic measures	(1.4%)	(0.2%)	(0.8%)	(0.4%)	(0.1%)
Regulatory measures	(1.3%)	(0.2%)	(0.8%)	(0.4%)	(0.1%)
Selected combination of economic and regulatory measures	(1.3%)	(0.2%)	(0.8%)	(0.4%)	(0.1%)

Per cent change between waste diversion scenario and current trend, 2000

Scenario	Gross output	Value added	Labour income	Taxes	Employment (person years)
Waste reduction action plan	(0.6%)	(0.1%)	(0.6%)	(1.5%)	(0.1%)
Economic measures	(0.6%)	(0.1%)	(0.6%)	(1.5%)	(0.1%)
Regulatory measures	(0.5%)	(0.1%)	(0.6%)	(1.5%)	(0.1%)
Selected combination of economic and regulatory measures	(0.5%)	(0.1%)	(0.6%)	(1.5%)	(0.1%)

All industries except transportation and the waste management sector are adversely affected by the Ontario waste reduction action plan scenario. These two sectors—which are major components of the Ontario environmental protection industry (EPI)—benefit from increased haulage and secondary market activities due to IC&I and residential programs (mandatory source separation, expanded *Blue Box* programs, and yard and organic waste collection programs). A major impetus for increased activity in these sectors from the IC&I sectors is the findings of (legislated) industrial waste audits. The industries which would be most affected by this scenario in 2000 are agriculture, food and beverage and other manufacturing industries as a result of changes in consumer expenditures and business investment. One of the primary reasons for changes in consumer expenditures is changing preferences due to mandatory source separation. Consumers, faced with such a requirement would shift their preferences to more durable, less packaged and less "waste-intensive" goods. Knowledge gained from industrial waste audits also has a similar impact on industrial output. The decline in agriculture is attributable to the decline in activities at tree nurseries, which are specifically geared for the forestry sector (i.e. with a decline in demand for forestry products, there would be fewer trees harvested, and fewer trees to be replaced.)

The decline in industrial output is partially offset by a limited expansion of the waste management sector (environmental protection industries related to waste management) whose activities will increase by 2000 as a result of increased recycling activities. The decline in provincial output will be felt most heavily in Northern Ontario where most primary resource extraction occurs (forestry and mining). Losses in the Greater Toronto Area (GTA), where many goods and services industries are located, will be large in the absolute sense, but only represents a decline of 0.06 per cent in GTA employment. Only Central Ontario is expected to receive positive economic impacts through increased transportation activities.

Negative impacts in the textiles, construction, trade and services sectors (Tables 31 to 34) are due to the sensitivity of these sectors to fluctuations (eg. recessions) within the Ontario economy. These sectors will experience a decline in output and employment and may be forced to respond by making structural changes, such as "down-sizing".

7.3 Economic measures scenario

In 1992, the economic measures scenario results in a gross output of $440.3 billion (1989$), which is $6.2 billion, 1.4 per cent, lower than the current trend in 1992. In 2000, GDP is forecast to increase to $470.2 billion (1989$) which is only $2.9 billion, 0.6 per cent, lower than the expected current trend. The value added decreases from the current trend in 1992 by $0.6 billion, or 0.2 per cent, and in 2000 by $0.5 billion from the current trend, or 0.1 per cent.

The resulting loss in labour income (consumer expenditures) arising from the economic measures scenario relative to the current trend is $1.2 billion (0.8 per cent of current trend labour income) in 1992 and $1.1 billion (0.6 per cent) in 2000. Government tax revenue (combined provincial and municipal) is expected to decrease by $ 0.2 billion, 0.4 per cent, in 1992 and $0.8 billion, 1.5 per cent, in 2000, relative to the current trend.

The economic measures scenario results in a decrease of 5,300 person years, or 0.1 per cent, of employment. In 2000, employment is expected to decrease 5,900 person years, or 0.1 per cent from the current trend total.

All industries except transportation and the waste management sector are affected by the economic measures scenario. These two sectors (which are major components of the EPI) benefit from increased haulage and secondary market activities. The industries most affected by this scenario in 2000 are agriculture, printing, food and beverage, and miscellaneous manufacturing industries as a result of changes in consumer expenditure and business investment. It is anticipated that packaging taxes, user charges and virgin materials taxes would have a significant impact on these sectors, with the exception of agriculture. Industries would have to alter their production mix to produce items which have a higher recycled content and less packaging. The remainder of these measures will have a limited impact. All of these measures invoke the "polluter pays" principle and create incentives for increased use of secondary materials in the manufacture of products. The decline in agriculture is attributable to the decline in activities at tree nurseries, which are specifically geared for the forestry sector (i.e. with a decline in demand for forestry products, there would be fewer trees harvested, and fewer trees to be replaced).

The decline in industrial output includes the waste management sector (environmental protection industries related to waste management) whose activities decrease by 2000 as a result of lower demand for waste management services. The decline in output will be felt most heavily in Northern Ontario where most primary resource extraction occurs (forestry and mining). Losses in the GTA, where many goods and services industries are located will be large in the absolute sense, but only represent a decline of 0.06 per cent in GTA employment, in both 1992 and 2000. Central Ontario is expected to receive positive economic impacts because of increased transportation activities.

Negative impacts in the textiles, construction, trade and services sectors (Tables 31 to 34) are due to the sensitivity of these sectors to fluctuations (eg. recessions) within the Ontario economy. These sectors will experience a decline in output and employment and may be forced to respond by making structural changes, such as "down-sizing".

It should be noted that the economic measures scenario only diverts slightly more waste than the WRAP scenario; and substantially less than the regulatory and selected combination scenarios. This is because small changes in pricing mechanisms (the net effect of the economic measures scenario) are not enough to encourage compliance at a level which is greater than any program which is currently being undertaken. However,

compared to the WRAP scenario, the costs of waste management to the province are substantially less - in 1992, an incremental cost of implementation of $200,000 (1989$), and in 2000, a provincial *savings* of $500,000 (1989$).

The economic measure scenario also results in the greatest declines in gross output and employment from the current trend. For 1992, gross output would be approximately $100 million (1989$), and approximately $200 million (1989$) in 2000, less than the WRAP scenario. Given the measures employed in this strategy, the cost of compliance will be primarily borne by the private sector. However, the private sector is sensitive to fluctuations (eg. recessions) in the economy. Any structural changes required by the private sector would be reflected in "down-sizing" (of an industry). Thus, declines in output and employment are greater than that of the WRAP scenario and the other scenarios which contain regulatory measures.

7.4 Regulatory measures scenario

In 1992, the regulatory measures scenario results in a gross output of $447 billion (1989$), which is $6.0 billion, 1.3 per cent lower than the current trend in 1992. In 2000, GDP is forecast to increase to $470.6 billion (1989$) which is only $2.5 billion, 0.5 per cent, lower than the expected current trend. The value added decreases from the current trend in 1992 by $0.5 billion, or 0.2 per cent, and in 2000 by $0.3 billion from the current trend, or 0.1 per cent.

The resulting loss in labour income (consumer expenditures) arising from the economic measures scenario relative to the current trend is $1.2 billion (0.8 per cent of current trend labour income) in 1992 and $1.1 billion (0.6 per cent) in 2000. Government tax revenue (combined provincial and municipal) is expected to decrease by $ 0.2 billion, 0.4 per cent, in 1992 and $0.8 billion, 1.5 per cent, in 2000, relative to the current trend.

The regulatory measures scenario results in a decrease of 5,300 person years, or 0.1 per cent, of employment. In 2000, employment is expected to decrease 5,820 person years, or 0.1 per cent from the current trend total.

All industries except transportation and the waste management sector are adversely affected by the regulatory measures scenario. The industries which would be most affected by this scenario in 2000 are agriculture, textiles, food and beverage, printing and miscellaneous manufacturing. It is anticipated that the decline in output in the latter three sectors is attributable to the imposition of recycled content regulation. These industries are affected as follows: food & beverage - compliance depends on the packaging industry's supply of an adequate quantity of material; printing - less virgin material is required in paper and packaging; and miscellaneous manufacturing - time to convert production technologies to utilize more secondary materials (see Appendix A). This decline in output is partially offset by the EPI (transportation and waste management sectors), whose output

will rise as the demand for haulage of secondary materials will increase (which is also due to landfill bans). Mandatory processing of solid waste collected would also lead to increase haulage and secondary market activity. Education programs, yard and organic waste collection, mandatory source separation and industrial waste audits will contribute to waste diversion and economic activity in a manner similar to the WRAP scenario. The decline in agriculture is attributable to the decline in activities at tree nurseries, which are specifically geared for the forestry sector (i.e. with a decline in demand for forestry products, there would be fewer trees harvested, and fewer trees to be replaced).

Negative impacts in the textiles, construction, trade and services sectors (Tables 31 to 34) are due to the sensitivity of these sectors to fluctuations (eg. recessions) within the Ontario economy. These sectors will experience a decline in output and employment and may be forced to respond by making structural changes, such as "down-sizing".

The decline in provincial output will be felt most heavily in Northern Ontario where most primary resource extraction occurs (forestry and mining). Losses in the GTA, where a great deal of goods and services industries exist, will be large in the absolute sense, but only represents a decline of 0.05 per cent in GTA employment, for both 1992 and 2000. Only Central Ontario is expected to receive positive economic impacts through increased transportation activities.

7.5 Selected combination of economic and regulatory measures scenario

In 1992, the selected combination of economic and regulatory measures scenario results in a gross output of $440.5 billion (1989$), which is $6.0 billion, 1.3 per cent, lower than the current trend in 1992. In 2000, GDP is forecast to increase to $470.5 billion (1989$) which is only $2.6 billion, 0.5 per cent, lower than the expected current trend. The value added decreases from the current trend in 1992 by $0.5 billion, or 0.2 per cent, and in 2000 by $0.3 billion from the current trend, or 0.1 per cent.

The resulting loss in labour income (consumer expenditures) arising from the economic measures scenario relative to the current trend is $1.2 billion (0.8 per cent of current trend labour income) in 1992 and $1.1 billion (0.6 per cent) in 2000. Government tax revenue (combined provincial and municipal) is expected to decrease by $ 0.2 billion, 0.4 per cent, in 1992 and $0.8 billion, 1.5 per cent, in 2000 relative to the current trend.

The selected combination of economic and regulatory measures scenario results in a decrease of 5,300 person years, or 0.1 per cent, of employment. In 2000, employment is expected to decrease 5,860 person years, or 0.1 per cent from the current trend total.

All industries except transportation and the waste management sector are adversely affected by the selected combination of economic and regulatory measures scenario. These

two sectors (which are major components of the EPI) benefit from increased haulage and secondary market activities. The industries which would be most affected by this scenario in 2000 are agriculture, textiles, miscellaneous manufacturing, and food and beverage industries as a result of changes in consumer expenditures and business investment. The decline in agriculture is attributable to the decline in activities at tree nurseries, which are specifically geared for the forestry sector (i.e. with a decline in demand for forestry products, there would be less trees harvested, and less trees to be replaced).

The decline in industrial output is offset by an expanded waste management sector (environmental protection industries related to waste management) whose activities will increase as a result of increased recycling activities, particularly in the transportation of recyclable materials. The decline in provincial output will be felt most heavily in Northern Ontario where most primary resource extraction occurs (forestry and mining). Losses in the GTA, where a great deal of goods and services industries exist, will be large in the absolute sense, but only represents a decline of 0.05 per cent in GTA employment, for both 1992 and 2000. Only Central Ontario is expected to receive positive economic impacts through increased transportation activities.

Negative impacts in the textiles, construction, trade and services sectors (Tables 31 to 34) are due to the fact that these sectors are sensitive to fluctuations (eg. recessions) within the Ontario economy. These sectors will experience a decline in output and employment and may be forced to respond by making structural changes, such as "down-sizing".

Compared to the regulatory scenario, the selected combination scenario diverts 4 per cent and 1 per cent more waste from landfill and incineration in 1992 and 2000, respectively. The combined effect of economic and regulatory measures has a significant impact in public sector spending, when compared to the WRAP and regulatory measures scenario. In 2000, the public sector costs of waste management for the selected combination scenario are less than half of the regulatory scenario ($4.6 million versus $10.5 million). This indicates that economic instruments, when used in tandem with regulatory controls, reduce public sector costs compared to strict regulatory regime (which requires monitoring and enforcement from the public sector). The combination of economic and regulatory measures induces a greater allocative efficiency (of financial and human resources) when implementing public sector programs.

Except for the waste diverted and public sector costs of waste management, the impacts of the regulatory and selected combination scenarios are relatively the same for 1992. However, in 2000, it is anticipated that gross output and labour income for the selected combination scenario will be approximately $100 million less than the regulatory measures scenario. It is the inclusion of economic measures that results in this decline in the selected combination scenario. The costs of the measures included in the economic measures scenario will be primarily borne by the private sector. The private sector is sensitive to fluctuations (eg. recessions) in the economy. Structural changes required by the private sector, as a result of these economic measures reflect "down-sizing" (of an

industry), more so than any regulatory measure. Therefore, any decline in output and unemployment will be greater than that of the regulatory measures scenario.

7.6 Summary of economic impacts

The following is a summary of the economic impacts of the four waste diversion scenarios relative to the current trend.

- The four waste diversion scenarios have marginally negative impacts on the Ontario economy as measured by gross output, value added (including business investment), labour income (consumer expenditures), taxes (provincial and municipal), and person years of employment, reflecting the relatively small size of the solid waste management sector in the Ontario economy, about $1 billion (1989$) of total direct expenditures in both 1992 and 2000. Also, the four waste diversion policy scenarios have little effect on the actual amount of public or private sectors expenditures on waste management but do change the relative distribution of these expenditures between waste disposal activities and 3R's programs.

- The economic measures scenario has a slightly greater negative impact on the Ontario economy (current trend) than the other three waste diversion scenarios because of its reliance on private sector compliance, who in response to the structural change in production required, "down-size" their operation. The regulatory measures scenario imparts the least impact on the Ontario economy compared to the other scenarios. The variation in the impact of these two scenarios reflects the different impact each scenario has on the waste management sector, in both the level of activity and the type of activities undertaken, and how these differences impact on the provincial economy. The economic measures scenario is the only scenario where the waste management sector (EPI activity related to waste management) is smaller in 2000 relative to the current trend, reflecting greater source reduction. The regulatory measures scenario results in the largest increase in size of the waste management sector by 2000, as a result of greater recycling relative to the other scenarios.

- Of the four scenarios, the economic measures scenario places the greatest cost of compliance on the private sector. The private sector, faced with user charges, packaging and virgin material taxes, and increased landfill tipping fees, will have to adjust their product mix through private initiatives, to reduce the burden of these added costs. Only when subsidies are offered to the private sector (i.e. to assist and/or induce compliance) would public sector costs be incurred. For the other scenarios, public sector funds are required to provide support for monitoring and enforcement of waste management initiatives.

- From an efficiency perspective, economic instruments allow for better allocation of public sector resources (financial and human) - when comparing the regulatory

scenario with the selected combination of regulatory and economic measures scenario, the latter achieves a higher diversion rate at less than half the cost to the public sector in 2000.

- The sectors that are primarily affected by these scenarios are agriculture, food and beverage, printing, miscellaneous manufacturing and textiles. Agriculture is affected through its relation to forestry—as less virgin paper stock is required, less trees will be harvested, and activity at tree nurseries is reduced in Ontario. These scenarios affect the food and beverage, printing and miscellaneous manufacturing sectors in changing the production mix of affected industries and requiring greater attention to "in-house" waste management activities. Impacts on the textiles sector are attributable to its sensitivity to fluctuations in demand within the Ontario economy. The textile sector will experience a decline in output and employment and may be expected to respond by making structural changes including "down-sizing".

- The scenarios suggest that the EPI sector will be a growth sector over the period 1992 to 2000. The transportation and waste management sectors will benefit from increased haulage and increased secondary market activities.

- The feedback mechanisms, through consumers' tastes and preferences, will reinforce the need and the desire for industries to comply with waste management measures.

- The economic impact of all four waste diversion scenarios is less in 2000 relative to 1992.

- Each scenario results in a decrease in economic activity in both 1992 and 2000 relative to the current trend.

- All four waste diversion scenarios have the same relative impact on the provincial value added, labour income, taxes and person years of employment in both 1992 and 2000.

- For each of the scenarios, the decline in provincial output and employment will be most prevalent in Northern Ontario where most primary resource extraction occurs (forestry and mining). Losses in the GTA, where many goods and services industries exists, will be large in the absolute sense, but only represents a decline of 0.05 per cent to 0.06 per cent in GTA employment, for both 1992 and 2000. The increased demand for transportation activities in Central Ontario leads to positive economic impacts in the region, the only region with a net positive impact.

7.7 Employment impacts

The macroeconomic impacts on person years of employment of each scenario and change in the export of the goods and services for Ontario were examined on sectoral employment and for six composite geographic regions in the Province. The change in exports reflects a reduction of 25 per cent in 1992 and 50 per cent reduction in 2000 of virgin pulp and newsprint exports, applied to the current trend export of pulp and newsprint. The export reduction scenario indicates the expected impact of recycling efforts outside Ontario on the provincial economy.

The 25 sectors used for analysis of the employment impacts of each scenario are those that correspond closely to IMC sectors for which data on waste generation coefficients are available. The aggregation of the counties included in each region is presented in Table 30. The effects on employment highlights the effects each scenario will have on the provincial economy relative to the current trend and a reduction in the export of pulp and newsprint.

Table 31 to Table 38 present the employment impact data associated with each of the scenarios for 1992 and the year 2000.

7.7.1 Changes in employment by industry

Exports reduction scenario

A loss of about 27 thousand person years of employment in 1992 relative to the current trend, occurs in the 25 per cent reduction of exports scenario (Table 31). This is equivalent to about one-half of one per cent of total person years of employment in Ontario in 1992 (Table 32). All industrial sectors are expected to lose person years of employment. About 70 per cent of the person years lost (19.2 thousand) are in the paper manufacturing, trade and services sectors of the economy.

A loss of 58 thousand person years of employment in 2000 relative to the current trend, occurs in the 50 per cent reduction of exports scenario (Table 33). This is equivalent to about one per cent of total person years of employment in Ontario in 2000 (Table 34). All industrial sectors are expected to lose person years of employment. About 70 per cent of the person years lost (41 thousand) are in the paper manufacturing, trade and services sectors of the economy.

The largest loss in employment relative to the current trend in the 25 per cent reduction of exports scenario (in 1992) are in the forestry (10 per cent), wood (3 per cent) and paper (13 per cent) sectors (Table 32). The major employment losses relative to the current trend in the 50 per cent reduction of exports scenario (in 2000) are as follows:

Table 30
County composition of regions

Eastern Ontario	Central Ontario	Southwestern Ontario
Stormont, Dundas, Glen.	Dufferin	Hamilton
Prescott & Russell	Wellington	St. Catharines-Niagara Falls
Ottawa-Carleton	Bruce	Haldimand-Norfolk
Leeds & Grenville	Grey	Brant
Lanark	Simcoe	Waterloo
Frontenac	Muskoka	Perth
Lennox & Addington	Haliburton	Oxford
Hastings (Trenton SA)		Elgin
Prince Edward (Belleville SA)		Kent
Northumberland (Cobourg SA)		Essex
Peterborough		Lambton
Victoria		Middlesex
Renfrew		Huron

Northeastern Ontario	Northwestern Ontario	Greater Toronto area
Nippissing	Thunder Bay	Durham (Oshawa SA)
Parry Sound	Rainy River	York
Manitoulin	Kenora	Toronto
Sudbury		Peel
Sudbury		Halton
Timiskaming		
Cochrane		
Algoma		

Table 31
Differences between current trend and scenarios, Ontario employment by industry, 1992, change in employment

	Industry						
Total person years	Agriculture	Forestry	Fishing	Mining	Food & beverage	Primary textiles	Knitting & weaving
Scenario	TRIM-1	TRIM-2	TRIM-3	TRIM-4	TRIM-5	TRIM-6	TRIM-7
25% export reduction	(607)	(1,159)	(2)	(80)	(380)	(100)	(148)
Waste reduction action plan	(273)	(11)	(1)	(93)	(170)	(47)	(86)
Economic	(263)	(10)	0	(90)	(164)	(46)	(83)
Regulatory	(287)	(12)	(1)	(98)	(179)	(50)	(91)
Selected combination of economic and regulatory	(282)	(11)	(1)	(97)	(176)	(49)	(90)

	Wood	Furniture	Paper	Printing	Primary metals	Fabricated metals	Machinery
Scenario	TRIM-8	TRIM-9	TRIM-10	TRIM-11	TRIM-12	TRIM-13	TRIM-14
25% export reduction	(719)	(68)	(7,209)	(305)	(66)	(131)	(55)
Waste reduction action plan	(31)	(48)	(67)	(122)	(35)	(90)	(55)
Economic	(30)	(46)	(65)	(118)	(34)	(86)	(52)
Regulatory	(33)	(50)	(71)	(128)	(37)	(94)	(57)
Selected combination of economic and regulatory	(32)	(49)	(69)	(126)	(36)	(93)	(56)

	Transport equipment	Electrical products	Non-metal	Refining/ petrochemical	Chemical	Miscellaneous manufacturing	Construction
Scenario	TRIM-15	TRIM-16	TRIM-17	TRIM-18	TRIM-19	TRIM-20	TRIM-21
25% export reduction	(170)	(150)	(51)	(149)	(361)	(298)	(252)
Waste reduction action plan	(115)	(100)	(28)	(2)	(87)	(165)	(571)
Economic	(112)	(96)	(27)	(2)	(83)	(158)	(550)
Regulatory	(121)	(106)	(29)	(2)	(91)	(173)	(599)
Selected combination of economic and regulatory	(120)	(104)	(29)	(2)	(90)	(170)	(591)

	Transportation	Trade	Services	Public administration	All industry
Scenario	TRIM-22	TRIM-23	TRIM-24	TRIM-26	TOTAL
25% export reduction	(2,954)	(4,527)	(7,493)	0	(27,434)
Waste reduction action plan	233	(1,861)	(1,503)	0	(5,329)
Economic	(6)	(1,791)	(1,446)	0	(5,358)
Regulatory	537	(1,952)	(1,577)	0	(5,301)
Selected combination of economic and regulatory	445	(1,925)	(1,555)	0	(5,308)

Table 32
Change between current trend and scenarios, Ontario employment by industry, 1992, per cent change in employment

Per cent	Agriculture	Forestry	Fishing	Mining	Food & beverage	Primary textiles	Knitting & weaving
Scenario	TRIM-1	TRIM-2	TRIM-3	TRIM-4	TRIM-5	TRIM-6	TRIM-7
25% export reduction	-0.46%	-9.79%	-0.27%	-0.19%	-0.38%	-0.47%	-0.40%
Waste reduction action plan	-0.21%	-0.09%	-0.07%	-0.22%	-0.17%	-0.22%	-0.23%
Economic	-0.20%	-0.08%	-0.05%	-0.21%	-0.16%	-0.22%	-0.22%
Regulatory	-0.22%	-0.10%	-0.10%	-0.23%	-0.18%	-0.24%	-0.24%
Selected combination of economic and regulatory	-0.21%	-0.09%	-0.10%	-0.23%	-0.17%	-0.23%	-0.24%

	Wood	Furniture	Paper	Printing	Primary metals	Fabricated metals	Machinery
Scenario	TRIM-8	TRIM-9	TRIM-10	TRIM-11	TRIM-12	TRIM-13	TRIM-14
25% export reduction	-2.90%	-0.17%	-13.45%	-0.39%	-0.10%	-0.15%	-0.11%
Waste reduction action plan	-0.13%	-0.12%	-0.13%	-0.16%	-0.05%	-0.11%	-0.11%
Economic	-0.12%	-0.11%	-0.12%	-0.15%	-0.05%	-0.10%	-0.10%
Regulatory	-0.13%	-0.12%	-0.13%	-0.16%	-0.05%	-0.11%	-0.11%
Selected combination of economic and regulatory	-0.13%	-0.12%	-0.13%	-0.16%	-0.05%	-0.11%	-0.11%

	Transport equipment	Electrical products	Non-metal	Refining/ petrochemical	Chemical	Miscellaneous manufacturing	Construction
Scenario	TRIM-15	TRIM-16	TRIM-17	TRIM-18	TRIM-19	TRIM-20	TRIM-21
25% export reduction	-0.08%	-0.15%	-0.20%	-0.74%	-0.67%	-0.30%	-0.07%
Waste reduction action plan	-0.06%	-0.10%	-0.11%	-0.01%	-0.16%	-0.17%	-0.16%
Economic	-0.05%	-0.09%	-0.10%	-0.01%	-0.15%	-0.16%	-0.15%
Regulatory	-0.06%	-0.10%	-0.11%	-0.01%	-0.17%	-0.17%	-0.16%
Selected combination of economic and regulatory	-0.06%	-0.10%	-0.11%	-0.01%	-0.17%	-0.17%	-0.16%

	Transportation	Trade	Services	Public administration	All industry
Scenario	TRIM-22	TRIM-23	TRIM-24	TRIM-26	TOTAL
25% export reduction	-0.63%	-0.36%	-0.46%	0.00%	-0.51%
Waste reduction action plan	0.05%	-0.15%	-0.09%	0.00%	-0.10%
Economic	0.00%	-0.14%	-0.09%	0.00%	-0.10%
Regulatory	0.12%	-0.16%	-0.10%	0.00%	-0.10%
Selected combination of economic and regulatory	0.10%	-0.15%	-0.10%	0.00%	-0.10%

Table 33
Differences between current trend and scenarios, Ontario employment by industry, 2000, change in employment

Industry

Total person years	Agriculture	Forestry	Fishing	Mining	Food & beverage	Primary textiles	Knitting & weaving
Scenario	TRIM-1	TRIM 2	TRIM-3	TRIM-4	TRIM-5	TRIM-6	TRIM-7
50% export reduction	(1,282)	(2,395)	(6)	(160)	(807)	(210)	(313)
Waste reduction action plan	(310)	(12)	(1)	(40)	(194)	(54)	(99)
Economic	(293)	(11)	(1)	(34)	(183)	(51)	(93)
Regulatory	(326)	(13)	(1)	(32)	(205)	(57)	(104)
Selected combination of economic and regulatory	(317)	(13)	(1)	(42)	(198)	(55)	(101)

	Wood	Furniture	Paper	Printing	Primary metals	Fabricated metals	Machinery
Scenario	TRIM-8	TRIM-9	TRIM-10	TRIM-11	TRIM-12	TRIM-13	TRIM-14
50% export reduction	(1,488)	(143)	(15,453)	(648)	(144)	(287)	(153)
Waste reduction action plan	(36)	(54)	(79)	(139)	(39)	(102)	(62)
Economic	(33)	(51)	(73)	(131)	(37)	(96)	(58)
Regulatory	(38)	(57)	(82)	(146)	(41)	(108)	(65)
Selected combination of economic and regulatory	(36)	(56)	(79)	(142)	(40)	(104)	(63)

	Transport equipment	Electrical products	Non-metal	Refining/ petrochemical	Chemical	Miscellaneous manufacturing	Construction
Scenario	TRIM-15	TRIM-16	TRIM-17	TRIM-18	TRIM-19	TRIM-20	TRIM-21
50% export reduction	(362)	(337)	(106)	(321)	(788)	(636)	(532)
Waste reduction action plan	(133)	(114)	(31)	(2)	(100)	(188)	(651)
Economic	(124)	(108)	(29)	(2)	(93)	(177)	(613)
Regulatory	(139)	(120)	(33)	(3)	(104)	(198)	(684)
Selected combination of economic and regulatory	(135)	(116)	(31)	(2)	(101)	(192)	(663)

	Transportation	Trade	Services	Public administration	All industry
Scenario	TRIM-22	TRIM-23	TRIM-24	TRIM-26	TOTAL
50% export reduction	(6,378)	(9,606)	(15,915)	0	(58,470)
Waste reduction action plan	407	(2,122)	(1,714)	0	(5,869)
Economic	(11)	(2,000)	(1,615)	0	(5,919)
Regulatory	769	(2,230)	(1,802)	0	(5,818)
Selected combination of economic and regulatory	537	(2,161)	(1,746)	0	(5,858)

Table 34
Change between current trend and scenarios, Ontario employment by industry, 2000, per cent change in employment

Per cent	Industry						
	Agriculture	Forestry	Fishing	Mining	Food & beverage	Primary textiles	Knitting & weaving
Scenario	TRIM-1	TRIM-2	TRIM-3	TRIM-4	TRIM-5	TRIM-6	TRIM-7
50% export reduction	-0.91%	-19.39%	-0.76%	-0.36%	-0.76%	-0.94%	-0.79%
Waste reduction action plan	-0.22%	-0.10%	-0.15%	-0.09%	-0.18%	-0.24%	-0.25%
Economic	-0.21%	-0.09%	-0.11%	-0.08%	-0.17%	-0.23%	-0.24%
Regulatory	-0.23%	-0.10%	-0.18%	-0.07%	-0.19%	-0.25%	-0.26%
Selected combination of economic and regulatory	-0.23%	-0.10%	-0.16%	-0.09%	-0.19%	-0.25%	-0.26%

	Wood	Furniture	Paper	Printing	Primary metals	Fabricated metals	Machinery
Scenario	TRIM-8	TRIM-9	TRIM-10	TRIM-11	TRIM-12	TRIM-13	TRIM-14
50% export reduction	-5.68%	-0.33%	-27.00%	-0.78%	-0.20%	-0.32%	-0.28%
Waste reduction action plan	-0.14%	-0.13%	-0.14%	-0.17%	-0.05%	-0.11%	-0.11%
Economic	-0.13%	-0.12%	-0.13%	-0.16%	-0.05%	-0.11%	-0.11%
Regulatory	-0.14%	-0.13%	-0.14%	-0.18%	-0.06%	-0.12%	-0.12%
Selected combination of economic and regulatory	-0.14%	-0.13%	-0.14%	-0.17%	-0.06%	-0.12%	-0.11%

	Transport equipment	Electric products	Non-metal	Refining/ petrochemical	Chemical	Miscellaneous manufacturing	Construction
Scenario	TRIM-15	TRIM-16	TRIM-17	TRIM-18	TRIM-19	TRIM-20	TRIM-21
50% export reduction	-0.17%	-0.31%	-0.39%	-1.51%	-1.38%	-0.61%	-0.14%
Waste reduction action plan	-0.06%	-0.11%	-0.11%	-0.01%	-0.17%	-0.18%	-0.17%
Economic	-0.06%	-0.10%	-0.11%	-0.01%	-0.16%	-0.17%	-0.16%
Regulatory	-0.06%	-0.11%	-0.12%	-0.01%	-0.18%	-0.19%	-0.18%
Selected combination of economic and regulatory	-0.06%	-0.11%	-0.12%	-0.01%	-0.18%	-0.18%	-0.17%

	Transportation	Trade	Services	Public administration	All industry
Scenario	TRIM-22	TRIM-23	TRIM-24	TRIM-26	TOTAL
50% export reduction	-1.29%	-0.73%	-0.92%	0.00%	-1.03%
Waste reduction action plan	0.08%	-0.16%	-0.10%	0.00%	-0.10%
Economic	0.00%	-0.15%	-0.09%	0.00%	-0.10%
Regulatory	0.16%	-0.17%	-0.10%	0.00%	-0.10%
Selected combination of economic and regulatory	0.11%	-0.16%	-0.10%	0.00%	-0.10%

paper (27 per cent); forestry (19 per cent); and wood (6 per cent) (Table 34). The most adversely affected sectors are those which are the primary employers in forestry products related sectors.

The loss in employment in the export reduction case is a result of a decreased demand for virgin pulp and newsprint in Ontario's export markets. These impacts are felt most heavily in Northern Ontario where most of the paper, wood and forestry sector activity is located.

Waste diversion policy scenarios

All four waste diversion policy scenarios result in a loss of about 5,300 person years of employment, 0.10 per cent of total person years of employment, in 1992. In 2000, the loss in employment is about 5,900 person years of employment, 0.10 per cent of total person years of employment. The regulatory measures scenario results in the smallest person years of employment lost in 2000, 5,800. This reflects the large increase in economic activity within the waste management sector that results from the regulatory measures scenario. In 2000, the greatest loss, over 5,900 person years of employment, results from the economic measures scenario. Job losses occur in all sectors (including the waste management sector). The larger impact of the economic measures scenario results from a lower level of activity in the waste management sector.

The only sector to show an increase in employment is the transportation sector. In both 1992 and 2000 the regulatory measures scenario results in the largest absolute increase in employment in the transportation sector. The selected combination of economic and regulatory measures scenario and the WRAP scenario also create person years of employment in the transportation sector. The increase in transportation employment in these scenarios is a result of increased recycling activities in and shifts in employment from waste disposal to 3R's activities in the waste management sector (environmental protection industries related to waste management).

The economic measures scenario is the only waste diversion policy scenario where a slight loss of person years of employment occurs in the transportation sector. This reflects the lower level of economic activity within the entire waste management sector resulting from this scenario.

The largest loss in employment relative to the current trend arising from the four waste diversion policy scenarios in both 1992 and 2000 are in the primary textiles (0.25 per cent) and knitting and weaving (0.25 per cent) and agriculture (0.20 per cent). The greatest loss in absolute person years of employment are in the construction, trade and services industries, about 75 per cent of total person years lost.

Person years of employment losses arise from decreased economic activity resulting from increased waste diversion activities in the province. These declines in employment are

partially offset by increased economic activity in the waste management sector in all scenarios except the economic measures scenario. (The increases in waste diversion activities shifts economic activity from final demand to intermediate demand in the macroeconomic model lowering sectoral employment estimated from final demand). Employment increases in the transportation sector result from increased activity in the recycling stream of the waste management sector. In addition shifts in employment from waste disposal to 3R's activities occurs in the waste management sector as more waste is diverted from landfill.

7.7.2 Changes in employment by region

Table 35 to Table 38 present the effects on person years of employment of the export reduction scenario and the four waste diversion scenarios by region for the years 1992 and 2000.

Table 35
Differences between current trend and scenarios, employment by region, 1992

Total person years Scenario	Eastern Ontario	Central Ontario	Southwestern Ontario	Northeastern Ontario
25% export reduction	(3,545)	(801)	(6,013)	(2,088)
Waste reduction action plan	(168)	116	(843)	(950)
Economic measures	(207)	108	(849)	(925)
Regulatory measures	(121)	126	(837)	(984)
Selected combination of economic and regulatory measures	(135)	124	(839)	(974)

Scenario	Northwestern Ontario	Greater Toronto Area	Total
25% export reduction	(2,547)	(12,439)	(27,434)
Waste reduction action plan	(1,987)	(1,496)	(5,328)
Economic measures	(1,930)	(1,556)	(5,357)
Regulatory measures	(2,061)	(1,423)	(5,300)
Selected combination of economic and regulatory measures	(2,038)	(1,445)	(5,307)

Table 36
Differences between current trend and scenarios, employment by region, 1992

Expressed as a per cent of total person years				
Scenario	Eastern Ontario (%)	Central Ontario (%)	Southwestern Ontario (%)	Northeastern Ontario (%)
25% export reduction	0.42	0.37	0.47	0.91
Waste reduction action plan	0.02	-0.05	0.07	0.42
Economic	0.02	-0.05	0.07	0.40
Regulatory	0.01	-0.06	0.07	0.43
Selected combination of economic and regulatory	0.02	-0.06	0.07	0.43
Scenario	**Northwestern Ontario (%)**	**Greater Toronto Area (%)**	**Total (%)**	
25% export reduction	2.37	0.46	0.51	
Waste reduction action plan	1.85	0.06	0.10	
Economic	1.79	0.06	0.10	
Regulatory	1.91	0.05	0.10	
Selected combination of economic and regulatory	1.89	0.05	0.10	

Exports reduction scenario

The largest absolute loss in person years of employment in the export reduction scenario is in the Greater Toronto Area (GTA), 12.5 thousand person years of employment in 1992 and 26.6 thousand person years of employment in 2000. On a percentage basis the largest person year losses are in Northwestern Ontario, about 2.4 per cent in 1992 and 4.7 per cent in 2000 of total regional person years of employment. In contrast, the GTA loses less than one per cent of total person years of employment. The large loss of employment in Northern Ontario reflects the impact recycling initiatives are expected to have on primary resource extraction and forestry related economic activities.

Waste diversion policy scenarios

The greatest absolute loss of person years of employment from the four waste diversion scenarios in both 1992 and 2000 are in Northwestern Ontario and the GTA. The economic measures scenario results in the fewest person years of employment lost in Northwestern Ontario and the largest person year losses in the GTA. Alternatively, the regulatory measures scenario results in the greatest losses in Northwestern Ontario person years of employment and the fewest losses in the GTA person years. The regional effect of these two scenarios reflects their different economic impact. The economic measures scenario

Table 37
Differences between current trend and scenarios, employment by region, 2000

Total person years Scenario	Eastern Ontario	Central Ontario	Southwestern Ontario	Northeastern Ontario
50% export reduction	(7,530)	(1,708)	(13,036)	(4,358)
Waste reduction action plan	(156)	133	(1,026)	(1,005)
Economic	(223)	118	(1,032)	(961)
Regulatory	(98)	145	(1,022)	(1,034)
Selected combination of economic and regulatory	(136)	137	(1,026)	(1,018)

Scenario	Northwestern Ontario	Greater Toronto Area	Total
50% export reduction	(5,287)	(26,551)	(58,470)
Waste reduction action plan	(2,171)	(1,644)	(5,869)
Economic	(2,075)	(1,748)	(5,920)
Regulatory	(2,252)	(1,556)	(5,818)
Selected combination of economic and regulatory	(2,200)	(1,614)	(5,857)

results in a decrease in waste management activities which occur mostly in the large urban areas while the regulatory measures scenario increases waste management activities in urban areas. The economic measures scenario also places less emphasis on recycling and a greater emphasis on source reduction than the regulatory measures scenario diminishing the adverse impact of waste diversion policies on the resource industries situated in Northern Ontario.

In both 1992 and 2000 the only region expected to have an increase in person years of employment is the Central Ontario region. This reflects increased waste management activities in the region, through the transportation of recyclable materials.

Table 38
Difference between current trend and scenarios, employment by region, 2000

Expressed as a per cent of total person years

Scenario	Eastern Ontario (%)	Central Ontario (%)	Southwestern Ontario (%)	Northeastern Ontario (%)
50% export reduction	0.84	0.75	0.96	1.80
Waste reduction action plan	0.02	-0.06	0.08	0.42
Economic	0.02	-0.05	0.08	0.40
Regulatory	0.01	-0.06	0.08	0.43
Selected combination of economic and regulatory	0.02	-0.06	0.08	0.42

Scenario	Northwestern Ontario (%)	Greater Toronto Area (%)	Total (%)
50% export reduction	4.66	0.93	1.03
Waste reduction action plan	1.91	0.06	0.10
Economic	1.83	0.06	0.10
Regulatory	1.98	0.05	0.10
Selected combination of economic and regulatory	1.94	0.06	0.10

7.8 Summary of employment impacts

A number of interesting results emerge from the employment impact tables.

- Export reduction and all four waste diversion scenarios result in lower employment relative to the current trend. This appears to result from the differences in inputs needed to sustain recycling activity.

- Levels of total employment are marginally sensitive to the waste diversion scenarios, but substantially sensitive to the export reduction scenario. A 25 per cent reduction in exports of newsprint and pulp results in a loss of 27,000 person years in 1992 (0.5 per cent of total employment) and a 50 per cent reduction in exports of newsprint and pulp results in 58,000 person years lost in the year 2000 (one per cent of total employment). In absolute terms, these job losses occur mostly in the south of the Province.

- The waste diversion scenarios reduce employment by a relatively modest amount of about 5 thousand jobs (0.10 per cent of total employment). This magnitude does not vary much between 1992 and the year 2000.

- The largest relative employment loss is associated with the adoption of economic measures scenario. Although, the employment losses are only slightly higher in the economic measures scenario relative to the other three policy scenarios, it is the result of a shift of some public sector waste management costs to waste generators (consumers and industry) and a decrease in the size of the waste management sector.

- Reductions in employment associated with recycling policies are the result of two opposing forces. A positive force resulting from increased activity in collecting, sorting and recycling and a negative force emanating from the increase in costs of recycling activities that must be met by reducing other expenditures. All the recycling scenarios considered in this study allocate the costs of waste management to the respective sectors. Households respond by cutting consumption, businesses by cutting investment expenditures and governments by reducing overall expenditures. The negative employment impacts are therefore the sum of the two opposing tendencies.

- A reduction in exports of newsprint and pulp reduces employment throughout the economy and regions, but its most severe impacts are concentrated in the paper, forestry, and wood industries, and in Northwestern Ontario. This is true in both 1992 and in the year 2000.

- The four waste diversion policy scenarios result in minor changes in employment between industrial sectors and regions relative to the current trend scenario. The industrial sectors which experience the largest change in employment are textiles, knitting and weaving and agriculture, and in Northwestern Ontario.

- Only one sector shows a rise in its employment level as a result of the various recycling policies. Transportation employment increases with all the recycling policies except under the economic measures scenario.

- The GTA sustains the largest absolute employment loss brought about by export reduction caused by recycling. Northwestern Ontario, however, shows the largest relative employment losses associated with the four waste diversion scenarios.

- When employment losses are expressed as percentage shares of total employment, Northwestern Ontario appears to be the most affected region. Employment losses in Northwestern Ontario as a result of a 25 per cent reduction in pulp and paper exports exceed 2.37 per cent of total local employment in 1992. This region appears to sustain most of the negative employment impacts associated with all the waste diversion scenarios. Alternatively, Central Ontario region shows employment gains as a result of the waste diversion scenarios.

8 Conclusions and recommendations

Four studies were undertaken for the Ontario Ministry of the Environment to gather comprehensive information on waste management practices in Ontario. Specifically information was collected regarding waste generation, the 3R's and the effects of different policy measures on provincial waste management practices. The first three of these studies provided information for Ontario on the physical and economic dimensions of municipal solid waste management, the market for 3R's activities and the true costs of municipal waste management.

The objectives of this study were to coordinate and synthesize the individual waste management studies and to assess the costs, benefits and consequences of waste management policy options on Ontario.

8.1 Conclusions

The following summarizes the general conclusions arising from the three waste management studies which the present study coordinated.

- Landfill is the method of disposal for most of Ontario's municipal solid waste. Less than two per cent of Ontario's municipal solid waste is incinerated. Residential waste recycling programs have increased dramatically in the last few years. One per cent of Ontario's municipal solid waste was recycled through residential recycling programs in 1987 and two per cent in 1989. At least a further three per cent of the total waste stream is recycled by the Ontario IC&I sector (CH2M Hill and MacLaren Engineers 1991).

- Increased tipping fees have encouraged 3R's, which can now be justified on an economic basis. Smaller communities are reluctant to raise tipping fees, because of a concern about illegal dumping of waste. Bans on accepting materials such as drywall, OCC, wood wastes, white goods, etc. at landfills are expected to stimulate increased 3R's of these waste streams (CH2M Hill and MacLaren Engineers 1991).

- Current waste generation and diversion practices in place and projected, as of December 31, 1990 are unlikely to divert sufficient quantities of waste to meet Ontario's waste diversion targets of 25 per cent by 1992 and 50 per cent by 2000 (The effect of possible policy options to achieve these targets as analyzed in the present study.) (RIS and VHB 1991).

- Markets for many secondary materials are not new. What is new is the collection of post-consumer (residential, commercial, institutional, retail) secondary materials through municipal recycling programs. This increase in the supply of secondary materials has resulted in large fluctuations in the price of these secondary materials. (RIS and VHB 1991).

- The following waste types provide the largest opportunities for increased waste diversion: fine paper; magazines; IC&I boxboard; glass containers; plastic (film); residential food and yard wastes; and industrial wood wastes (RIS and VHB 1991).

- For some waste types, such as boxboard, telephone books, disposable diapers, etc., limited or no secondary markets exist. However, the pressure to take full responsibility for the wastes associated with a particular product is leading producers to assist in the development of 3R's activities and markets to absorb and reprocess these materials. In developing initiatives to stimulate current and create new markets for secondary materials, the structure and operation of existing markets is important.

- Although there are wide variations from facility to facility, the total waste management costs for landfills are $46 per tonne. This includes $12 per tonne for waste disposal and $34 per tonne for waste collection. The total cost for incinerators is $81 per tonne, including $34 per tonne for waste collection. The per tonne unit cost for recycling facilities is $181. The average revenue per tonne of recyclable materials collected is $78 per tonne. New landfills will be more expensive: typical costs are likely to be $40 per tonne. Costs at very small facilities will be even higher (VHB and MacLaren Engineers 1991).

The conclusions arising from the analysis of the economic impacts of the five waste diversion scenarios on the Ontario economy are as follows.

- The current trend scenario indicates that 14 per cent of waste will be diverted from landfill in 1992 and 23 per cent in 2000. The total cost of solid waste management is $843 million in 1992 and $947 million in 2000.

- The regulatory measures and the selected combination of economic and regulatory measures scenarios exceed the 1992 waste diversion target. The incremental cost of achieving the 1992 target using regulatory measures is about $60 million (1989$) while the incremental cost of achieving the target using selected combination of economic and regulatory measures is less, $42 million (1989$). The economic measures and the WRAP both achieved the 1992 waste diversion target. The economic measures scenario incurs the least incremental costs, $2 million (1989$) and the WRAP, $21 million (1989$).

- The regulatory measures and the selected combination of economic and regulatory measures scenario almost achieve the 2000 waste diversion target. The incremental cost of achieving the 2000 target is $105 million under the regulatory measures scenario and $46 million (1989$) under the selected combination of economic and regulatory measures scenario. The regulatory measures scenario is the most costly for achieving the 2000 waste diversion target. The decrease in incremental cost from 1992 to 2000 for the selected combination of economic and regulatory measures scenario results from the greater input of low cost measures in the longer term. And the inclusion of economic measures lowers the direct cost of achieving the waste management diversion target by having the cost of some measures assumed by waste generators. Neither the economic measures nor the WRAP achieve the 2000 waste diversion target.

- To achieve the 2000 target of a 50 per cent diversion of waste, *other* wastes must also be assumed to be affected by various policy measures. *Other* wastes constitute 25 per cent of residential and 19 percent of IC&I in 2000.

- All four waste diversion policy scenarios contribute marginally to the total costs of waste management. The economic measures scenario reduces waste management costs by only $5 million in 2000 (less than one per cent of total waste management costs). The regulatory measures scenario results in the greatest increase in total waste management costs, $105 million in 2000, increasing waste management costs by 11 per cent over the current trend.

- The four waste diversion scenarios do not have a significant impact on the Ontario economy although each scenario results in a decrease in economic activity in both 1992 and 2000 relative to the current trend. The results reflect the relatively small size of the solid waste management sector in the Ontario economy, less than $1 billion (1989$) of total direct expenditures in both 1992 and 2000. Also, the four waste diversion policy scenarios have little effect on the actual amount of public or private sectors expenditures on waste management but do change the relative distribution of these expenditures between waste disposal and 3R's programs. The economic impact of all four waste diversion scenarios is less in 2000 relative to 1992.

- Levels of total employment are marginally sensitive to the waste diversion policy scenarios, but substantially sensitive to the export reduction scenario. The waste diversion scenarios reduce employment by a relatively modest amount of about 5 thousand jobs (0.10 per cent of total provincial employment). This magnitude does not vary much between 1992 and the year 2000. A 25 per cent reduction in exports of newsprint and pulp results in a loss of 27,000 person years in 1992 (0.5 per cent of total provincial employment) and a 50 per cent reduction in exports of newsprint and pulp results in 58,000 person years lost in the year 2000 (one per cent of total provincial employment).

- The largest relative employment loss is associated with the adoption of economic measures scenario. Although, the employment losses are only slightly higher in the economic measures scenario relative to the other three policy scenarios, it is the result of a shift of some public sector waste management costs to waste generators (consumers and industry)

- A reduction in exports of newsprint and pulp reduces employment throughout the economy and regions, but its most severe impacts are concentrated in the paper, forestry, and wood industries, and in Northwestern Ontario. This is true in both 1992 and in the year 2000. The four waste diversion policy scenarios result in minor changes in employment between industrial sectors and regions relative to the current trend scenario. The industrial sectors which experience the largest change in employment are textiles, knitting and weaving and agriculture, and in Northwestern Ontario.

- Only one sector shows a rise in its employment level as a result of the various recycling policies. Transportation employment increases with all the recycling policies except under the economic measures scenario. Increases in transportation employment result from increased collection and hauling of recyclable materials.

- When employment losses are expressed as percentage shares of total employment, Northwestern Ontario appears to be the most affected region. This is particularly true of the 25 per cent reduction in pulp and newsprint exports scenario.

8.2 Recommendations

The following recommendations are based on the three previous waste management studies and the economic analysis undertaken in this study.

- Comprehensive records of waste disposal at landfills and incinerators have not been maintained in Ontario, hence reliable waste generation information is not available for many locations in the Province. In the past, very little information was collected on the composition of MSW. This has changed in the last year or two, with the landfill crisis in Southern Ontario, and the need to divert more materials from landfill. Many Ontario municipalities are now embarking on waste audits and waste composition studies to better define the components of the waste stream. The information should be collected in a consistent manner by all municipalities and placed in a central data bank (CH2M Hill and MacLaren Engineers 1991).

- Most facilities have very little information about costs and revenues for waste management. Monitoring of waste inputs, costs and revenues should be part of waste management facility monitoring requirements (VHB and MacLaren Engineers 1991).

- Specific initiatives designed to assist in increasing the volume of recyclable materials collected and to accommodate these materials in the market place should be implemented by the government and may include: monitoring and providing market information and financial support to suppliers and end-users of secondary materials; developing clear and equitable regulations for waste diversion; and instituting provincial government procurement guidelines favouring products made from post-consumer secondary materials (RIS and VHB 1991).

- Complete data are not available on the percentage of municipal solid waste recycled by the IC&I sector. Anticipated trends in 3R's include a greater focus on composting organic wastes. More research should be carried out in this area. (CH2M Hill and MacLaren Engineers 1991).

- Municipalities should expand the *Blue Box* Program beyond the traditional four materials (newspaper, glass, metal and PET). Some municipalities have included corrugated cardboard, phone books and household hazardous waste in their programs. Other municipalities are experimenting with including film plastic, boxboard, magazines and fine paper in their programs (CH2M Hill and MacLaren Engineers 1991).

- External social costs of landfills and incinerators are not well understood, but appear to be quite minor (i.e. less than 10 per cent of replacement costs). External costs and benefits of recycling are largely unknown. An assessment of the social costs and

benefits of recycling should be undertaken to assist in determining priorities for public funds (VHB and MacLaren Engineers 1991).

- A surcharge should be placed on tipping fees to cover (some) external social costs, and to provide funds for closure and post–closure care. Tipping fees should be raised at landfills where these fees are lower than the cost of managing the waste. Facility management costs should include all management aspects (VHB and MacLaren Engineers 1991).

- Ontario facilities rely primarily upon general revenues and tipping fees to finance waste management facilities. At the largest facilities, tipping fees are well in excess of costs; at most small facilities, tipping fees (where they exist at all) are below the average cost per tonne of waste managed. Other revenue generation mechanisms have been introduced in other jurisdictions and may help Ontario meet its goals of diverting waste from disposal and making the waste management system "financially sustainable". Some of these—like deposit charges—are effective but expensive. The effectiveness of others—like pay–by–the–bag systems—has not been well documented. New revenue generation mechanisms should be tested, with analysis of pilot implementations to assess effectiveness and impacts (VHB and MacLaren Engineers 1991).

The following recommendations are based on the analysis of the waste diversion policy scenarios undertaken in this report.

- The major impacts of the waste diversion policy scenarios analyzed are on the distribution of costs and benefits between regions and sectors of the Province. Further sectoral and regional analysis of these impacts, particularly on northern Ontario and the forestry/forest products industries should be conducted.

- The waste diversion policy scenarios result in a relatively marginal impact on the provincial economy. However, the provincial economy is sensitive to the waste management policies adopted by its major trading partners. Research should be undertaken to develop a comprehensive information base of the current and planned waste management policies of Ontario's trading partners and how these policies will affect Ontario's ability to export virgin materials and products (e.g. pulp and newsprint).

- The macroeconomic impact analysis is of four waste diversion scenarios based on a set of 18 waste diversion measures included in the WMPM. These scenarios do not include the full range of measures available for waste diversion. The WMPM should be modified to include additional waste diversion measures.

- The WMPM is non-optimizing. It does not estimate the most effective or efficient scenario for achieving a waste diversion objective. Further research should be conducted to identify efficient and effective waste diversion scenarios at the provincial, regional and municipal levels. The WMPM should be used to explore the consequences of alternative scenarios not presented in this report.

- Reductions in employment associated with recycling policies are the result of two opposing forces. A positive force resulting from increased activity in collecting, sorting and recycling and a negative force emanating from the increase in costs of recycling activities that must be met by reducing other expenditures. All of the waste diversion scenarios considered in this study allocate the costs of waste management to the respective sectors. Households respond by cutting consumption, businesses by cutting investment expenditures and governments by reducing overall expenditures. Further research into these changes and shifts in economic activity resulting from recycling and other waste diversion activities should be conducted to successfully develop secondary materials markets and to implement worker retraining or business investment programs in the industrial sectors adversely affected.

- CH2M Hill (1991) presented waste generation data at the county level and the macroeconomic analysis reported results at the regional level. Such disaggregation was not available from the WMPM due to a lack of waste composition and waste diversion data at the county or regional level. Modification of the WMPM to include regional impacts should be undertaken to enhance local waste diversion policy analysis.

- No provision was provided within the WMPM for the export of waste from Ontario. The WMPM should be expanded to include the export of waste or recyclable materials from Ontario.

9 Bibliography

ASTM. 1975. *Resource Recovery and Utilization,* Proceedings of the National Materials Conservation Symposium.

Albrecht, O.W. 1976. An Evaluation of User Charges for Solid Waste Collection and Disposal. *Resource Recovery and Conservation* 2:355-360.

Association of Municipalities of Ontario. 1989. The Municipal Abatement Strategy. *Waste Management Series.*

Biles, S. 1987. *A Review of Municipal and Hazardous Waste Management Practises and Facilities in Seven European Countries,* Prepared for the German Marshall Fund of the United States.

Bingham, T.H., et al. 1983. Conditionally Predictive Supply Elasticity Estimates: Secondary Materials Obtained from Municipal Residuals. *Journal of Environmental Economics and Management* 10:166-179.

BioCycle. December, 1990. *Journal of Waste Recycling.*

BioCycle. January, 1991. *Journal of Waste Recycling.*

BioCycle. February, 1991. *Journal of Waste Recycling.*

BioCycle. March, 1991. *Journal of Waste Recycling.*

Canada. Government of Canada. 1990. *Canada's Green Plan.*

CH2M Hill Engineering Ltd. 1991. *The Physical and Economic Dimensions of Municipal Solid Waste Management in Ontario.* Toronto: Ontario Ministry of the Environment.

City of Portland. Solid Waste Department. 1989. *Metro Waste Characterization Study 1989/90 Sort #1 (Spring Season).* Portland Metropolitan Service District.

City of Seattle. Seattle Solid Waste Utility. 1989. *Solid Waste Utility: Waste Stream Composition Study 1988-1989.* City of Seattle. Prepared by The Matrix Management Group.

City of Seattle. Seattle Solid Waste Utility. 1990. *Yard Waste Monthly Report.*

Conn W.D. 1976. The Treatment of Resource Recovery in Solid Waste Plans. *Resource Recovery and Conservation* 2:365-372.

Environment Council of Alberta. 1987. *Recycling of Waste in Alberta: Technical Report and Recommendations.* Alberta. Prepared for the Environment Council of Alberta.

Environmental Defense Fund. 1990. *Recycling & Incineration Evaluating the Choices.* Edited by Richard A. Denison and John Ruston. Washington: Island Press.

Franklin Associates Ltd. 1986. *Characterisation of Municipal Solid Waste in the United States, 1960-2000.* Prepared for the U.S. Environmental Protection Agency.

Franklin Associates Ltd. 1987. *Feasibility of Tax Incentives for Purchases of Recycling Equipment of Recycled Products.* Illinois Department of Energy and Natural Resources.

Franklin Associates Ltd. 1988. *Economic Incentives and Disincentives for Recycling of Municipal Solid Waste.* Kansas. Prepared for The Congress of the United States, Office of Technology Assessment.

Franklin Associates, Ltd. 1989. *The Role of Beverage Containers in Recycling and Solid Waste Management.* Prepared for Anheuser-Busch Companies.

Hansen, T. 1986. Today's Wastes are Tomorrows Resources. *Resources and Conservation,* 193-201.

Hartwick, J.M., and N.D. Olewiler. 1986. *The Economics of Natural Resource Use.* Cambridge.

Hirsch, W. 1965. Cost Functions of an Urban Government Service: Refuse Collection. *Review of Economics and Statistics* 47:87-92.

Holmes, J.R. 1981. *Refuse Recycling and Recovery*. John Wiley & Sons.

Lindhqvist, T. 1989. *The Deposit System — Swedish Experiences Concerning Present and Proposed Systems*. The Hague: ECE Seminar on Economic Implications of Low-waste Technology.

Martin, E. 1990. *Analysis of the Effectiveness of the Ontario Bluebox System of Collection of Soft Drink Containers*. unpublished notes.

Marvin Shaffer and Associates and VHB Research and Consulting Inc. 1990. *Evaluation of Alternative Beverage Container Recovery Programs*. Victoria: British Columbia Ministry of Environment.

McRobert, D., et al. 1990. *Five Years of Failure*. Toronto: Pollution Probe.

Miedema, A.K., et al. 1976. *The Case for Virgin Material Charges: A Theoretical and Empirical Evaluation in the Paper Industry*. Triangle Institute. Prepared for the U.S. Environmental Protection Agency.

M.M. Dillon Limited and Cal Recovery Systems Inc. 1990. *Composting, A Literature Study*. Prepared for the Ontario Ministry of the Environment. Toronto: Queen's Printer.

OECD. 1978. *Beverage Containers*. Paris: Organization for Economic Cooperation and Development.

OECD. 1981. *Economic Instruments in Solid Waste Management*. Paris: Organization for Economic Cooperation and Development.

OECD. 1983. *Household Waste, Separate Collection and Recycling*. Paris: Organization for Economic Cooperation and Development.

Office of Technology Assessment, United States, Congress, 1989. *Facing America's Trash: Next for Municipal solid Waste*. OTA-O-424.

Ontario. Ministry of Energy and Ministry of the Environment. 1991. *Wood Waste Generation and Management in Ontario*. Toronto: Queen's Printer.

Ontario. Ministry of the Environment. 1989. *Environment Ontario - Facts about the Municipal Recovery Program.*

Ontario. Ministry of the Environment. 1989. *Environment Ontario - The Comprehensive Funding Program for Waste Management, Facts for Municipalities.*

Ontario. Ministry of the Environment. 1990a. *Highlights and Trends 1990-91 Estimates.*

Ontario. Ministry of the Environment. 1990b. *Environment Ontario - Waste Management Master Planning.*

Ontario. Ministry of the Environment. 1990c. *Towards a Sustainable Waste Management System.* Discussion Paper.

Ontario. Ministry of the Environment. 1991. *Ontario's Waste Reduction Action Plan: Backgrounder.* Environment — Information — Environnement February 21, 1991.

Ontario NDP Caucus. 1990. *Greening the Party, Greening the Province: A vision for the Ontario NDP.*

Pilorusso Research Associates Inc., Et al. *Scrap Tire Management in Ontario.* Prepared for the Ontario Ministry of the Environment. Toronto: Queen's Printer.

Porteous, A. 1977. *Recycling Resources Refuse.* Longman Group Limited.

Proctor & Redfern Group. 1989. Solid Waste Management Approaches, Component 3. *Markets for Materials from Solid Waste.* SWEAP Discussion Paper 3.4.

Quon, J., M. Tanaka, and A. Charnes. 1976. Refuse Quantities and Frequency of Service. *Journal of Sanitary Engineering* 94:401-420.

Resource Integration Systems Limited and VHB Research and Consulting Inc. 1991 *Market Assessment of 3R's Activities in Ontario.* Toronto: Ontario Ministry of the Environment.

Richardson, R.A. and Havlicek, J.J. 1978. Economic Analysis of the Composition of Household Solid Wastes. *Journal of Environmental Economics and Management* 5:103-111.

Rubin, C. 1989. *The Organic Approach to Home Gardening.* Prepared for Friends of the Earth-Canada.

Shrybman, S. 1989. *A Regulatory Agenda for Solid Waste Reduction.* Toronto: Canadian Institute for Environmental Law & Policy.

State of Washington. 1987. *Best Management Practices Analysis for Solid Waste Vol.1.: 1987 Recycling and Waste Stream Survey.* State of Washington. Prepared for

Washington Department of Ecology, Office of Waste Reduction and Recycling. Prepared by the Matrix Management Group.

State of Washington. 1989a. *Best Management Practices Analysis for Solid Waste Vol.2.: Regional Analysis and Market Assessment.* State of Washington. Prepared for Washington Department of Ecology, Office of Waste Reduction and Recycling. Prepared by the Matrix Management Group.

State of Washington. 1989b. *Best Management Practices Analysis for Solid Waste Vol.3.: Statewide Findings and Recommendations.* State of Washington. Prepared for Washington Department of Ecology, Office of Waste Reduction and Recycling. Prepared by The Matrix Management Group.

State of Washington. 1989c. *Best Management Practices Analysis for Solid Waste Vol.4.: Executive Summary.* State of Washington. Prepared for Washington Department of Ecology, Office of Waste Reduction and Recycling. Prepared by The Matrix Management Group.

SWEAP. 1990. *News* 18. Toronto: Solid Waste Department.

SWEAP. 1990. *News* 19. Toronto: Solid Waste Department.

SWEAP. 1990. *News* 20. Toronto: Solid Waste Department.

Sweden. Swedish Association of Public Cleansing and Solid Waste Management. 1988. *Solid Waste Management in Sweden.*

Taylor, A.C. and R.M. Kashmanian. 1988. *Study and Assessment of Eight Yard and Waste Composting Programs Across the United States.* Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency. EPA/530-SW-89-038.

Tellus Institute. 1990a. *Environmental Impacts of Packaging Production.* Prepared for The Council of State Governments.

Tellus Institute. 1990b. *Literature and Public Policy Review.* Lexington. Prepared for The Council of State Governments.

Tillman, D.A. 1976. Comparison of Two Government Reports as to Their Approaches to Recycling. *Resource Recovery and Conservation* 2:361-364.

United States, Environmental Protection Agency. 1972. *Comprehensive Studies of Solid Waste Management.* SERL No. 72-3.

United States, Environmental Protection Agency. 1977. *Resource Recovery and Waste Reduction*. Washington: Fourth Report to Congress.

VHB Research & Consulting Inc. and MacLaren Engineering Ltd. 1991. *True Costs of Municipal Waste Management*, Toronto: Ontario Ministry of the Environment.

Webb, C. 1985. *Economic Barriers to Recycling*. Edmonton. Environment Council of Alberta.

Wertz, K.L. 1976. Economic Factors Influencing Households' Production of Refuse. *Journal of Environmental Economics and Management* 2:263-272.

Zimmermann, E. 1988. *Solid Waste Management Alternatives: Review of Policy Options to Encourage Waste Reduction*, Prepared for Illinois Department of Energy and Natural Resources, Energy and Environmental Affairs Division.

Appendix A Detailed description of measures

Detailed description of measures

Appendix A provides a detailed description of the 18 measures examined for development of the waste diversion scenarios. A description and a review of the literature for each measure is provided. In addition the efficiency, equity and distributive effects of each measure are outlined as well as the diversion potential of each measure.

The diversion potential of each measure by waste type is presented for the two years, 1992 and 2000, estimated by the WMPM. The per cent diverted of each waste type for a given measure presented in the text and tables below is *the incremental increase in waste diverted in that year as a result of that measure as compared to the current trend.* For example, if the current trend recycling rate of mixed paper is 10 per cent in 1992 and 20 per cent in 2000 and the recycling diversion potential of a measure is 10 per cent in 1992 and 30 per cent in 2000, then the incremental increase in the recycling rate of mixed paper is 9 per cent (0.10 X 0.90) in 1992, increasing the total recycling rate to 19 per cent, and 24 per cent (0.30 X 0.80) in 2000, increasing the total recycling rate to 44 per cent.

Where appropriate, the implementation costs of a measure are provided. These costs are the *additional operating and capital implementation costs incurred by the Province*. The costs of capitalizing and operating the total solid waste management sector (administration, collection, disposal, recycling, transportation) are paid by municipalities and the private sector, these costs are calculated separately by the WMPM. For example, the implementation costs of expanded *Blue Box* programs equal the expected increase in provincial support grants (e.g. through MSRP) to municipalities for the expanded programs. Total implementation costs of the measure are not calculated, only the incremental implementation costs for the target years, 1992 and 2000. The costs (operating and capital expenses) of collecting, processing and sorting recyclable materials are not included as implementation costs and instead are determined by the WMPM (see, Chapter 4).

A.1 User charges

A user charge is a payment for waste disposal based upon the characteristics of the waste involved.[1] A user charge is usually calculated according to the weight or volume of the waste, but can relate to other parameters such as the difficulty of disposal and treatment, and toxicity (OECD 1982;12). User charges provide an incentive for waste generators to reduce their volume of waste and change its composition. Typically, these charges are applied to residential waste, but they can also be applied to industrial, commercial, and institutional (IC&I) waste.

Crucial to the implementation of a user charge is the determination of the level of the charge. To allow waste generators to make decisions based on the costs of waste disposal, the user charges should equal the full cost of such a service. This implies that user charges should take into account: fixed and operating costs of waste collection; fixed and operating costs of landfills including the costs of site closure and post-closure site monitoring; and any external social costs of solid waste management.

However, all these costs are not usually included in the determination of user charges. Municipalities which currently have user charge systems typically cover only the fixed and operating costs of their collection and disposal systems (VHB 1991). This is due to two factors:

- people may resort to alternative unacceptable waste disposal methods(i.e., illegal dumping); and
- waste disposal is regarded as a "free" service or a service already paid for through taxes, and so a user charge may be resented.

A.1.1 Empirical studies

In one of the earliest studies of user pay systems in California, a relationship between the price of household waste disposal services and the level of such services was found that suggested that for every 10 per cent increase in user charges, there would be a 4.4 per cent reduction in the volume (weight) of the waste generated (OECD 1981;12).

Two other studies conducted in California during the 1970's, also concluded that user charges reduce the quantity of waste for disposal (OECD 1981;13). In San Francisco, household solid

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[1] Alternatively, a user charge can be defined as a charge which varies with the type of service provided to a particular use. That is, the charge varies with the choice of service.

waste collection amounted to 318 kg per capita per annum in 1970, compared with 462 kg in other California communities where no charges existed and solid waste collection and disposal was financed by general taxes. In San Leandro, California, residential solid waste is 60 per cent less in communities with user charges.

There are two types of user charge systems commonly used:

- pay-by-the-bag systems, waste generators must pay for each trash bag they put out for collection; and
- variable-rate systems, waste generators may pay according to the frequency of service, the number of containers or the type of service the choose.

Pay-by-the-bag system

The pay-by-the-bag system is quite popular in the United States. This is probably due to its simplicity and its ease on implementation - waste generators are required to pay a set amount for each bag or any other piece of waste they set out for collection (VHB 1991).

There are a number of examples of existing pay-by-the-bag systems:

- Perkasie, Pennsylvania, has operated a pay-by-the-bag system since 1988, in conjunction with a recycling program. Perkasie residents must place their trash out for collection in an official municipal bag. The bags are obtained from local stores and Borough offices, and come in 9 kg and 18 kg sizes and sell for $0.80 and $1.50, respectively. Approximately 90 per cent of the bags are of the large size. Based on a comparison of the average annual quantities of waste disposed of from 1985 to 1987 with the quantity disposed of in 1988, a 59 per cent reduction in waste sent to landfill after the implementation of the recycling and pay-by-the-bag programs. The quantity of recyclable material collected during 1988 accounts for 28 per cent reduction. The remaining 31 per cent was accounted for by commercial customers opting out of the new system in favour of a private waste collection during autumn 1988; illegal disposal of waste or burning; and export of waste to other municipalities. It is likely that the separate collection of yard wastes, which contribute significantly to solid generation in the spring and fall, accounted for a large proportion of the remaining 31 per cent reduction.
- High Bridge, New Jersey, began its pay-by-the-bag system in 1988. Under the system, residents are charged an annual fee of $200 (U.S.) and receive 52 stickers, which permit them to place one 113 L bag or container out for collection each week. Households which require more than one sticker per week must order them in batches of 10 at a cost of $16.50 (U.S.) from the Borough Hall. The use of stickers

for this system was based on the relatively lower costs of purchasing and handling stickers.

In 1988, waste disposal in High Bridge was down 24 per cent over 1987 levels. However, disposal is sensitive to markets for secondary materials. In 1989, the town's markets for recyclable mixed paper and magazines weakened and, as a result, waste disposal was only 15 per cent below 1987 levels.

- Flemington, New Jersey, employs a system where each customer receives two stickers each week and charges $1.65 for each additional sticker. The system has been in place since January 1, 1990. As the program is still new, there is little information on its effectiveness. However, the Deputy Municipal Clerk felt that the recycling rate was up as a result of the program.

- Carlisle, Pennsylvania, has operated its "Borough Bags" program for over ten years. Municipal customers must use official bags for their waste: $1.10 for 113 L bag or $0.60 for a 57 litre bag. The effectiveness of this program is currently under review.

- Lansing, Michigan, has operated a pay-by-the-bag system since 1972. The City sells official (orange) trash bags for 75 cents each through a variety of local retail stores. The effectiveness of this program is currently under investigation.

Variable-rate systems

Variable-rate systems provide the customer with the opportunity of choosing a particular level of service. Customers choose an option to satisfy their individual needs and are charged according to the level of service they choose. An external billing system is required to implement a variable-rate system. Typically, waste collection charges are added to a monthly utility bill. There are a number of examples of variable-rate systems currently in operation (VHB 1991):

- Seattle, Washington, has had a variable rate system that allows customers to choose among a wide range of service options since 1961. Between 1981 and 1988, the average number of containers subscribed to by single family customers fell from 3.4 to 1.4 - a decrease of 59 per cent (City of Seattle, 1989;110). Further, in 1988 there was a 82 per cent increase to $13.55 U.S. per month for the weekly collection of one 113 L container. The quantity of residential waste, by weight, that Seattle disposed of through landfill declined by 10 per cent for the year (City of Seattle 1989;65).

  Seattle provides a number of other financial mechanisms which are intended to provide individuals with incentives for further waste reduction. These mechanisms

include: trash tags, bulky item pick-up, yard waste collection, diversion credits for apartment recycling, and surtaxes on commercial waste haulers.

Seattle's yard waste collection program charges a fee of $2 per month, which allows customers to put out up to twenty 27 kg bundles of yard waste for collection each month. The alternative is self-hauling yard waste to one of the City's transfer stations, where the customer is charged $4 per trip. The combination of curbside and self-hauled yard waste was 46 per cent higher than expected. The success of the program may be a result of its quick start up, low cost and convenience.

- A series of studies in Chicago related the amount of waste generated to the frequency of collection. The studies determined that living units serviced twice a week set out about 30 per cent more refuse (by weight) per week than living units that were serviced only once a week (Wertz 1977;267).

- San Francisco, California, residents are charged directly for the number of containers they subscribe to, at a rate of $8.50 (U.S.) for the first can and $3.50 (U.S.) for every subsequent can.

A.1.2 Efficiency

User charges, in theory, increase the efficiency of municipal solid waste management. User charges provide waste generators the option of altering their waste collection service level in order to economise on scarce economic resources. There is also the argument that devising and implementing user charges requires accurate cost analysis, which may lead to improved management (OECD 1981;13).

As user charges vary according to the level of services provided, they offer "a means of payment for waste collection and disposal that is more consistent with the *Polluter Pay Principle,* than predominantly used in the flat-fee and local tax-financed systems"[2] (OECD 1981;13).

The empirical evidence presented on pay-by-the-bag systems for Perkasie and High Bridge suggests that the cost of solid waste management services to individuals can fall as a result of implementing user charges. However, the "waste disposal reduction" experience of these two communities is relatively short. It is also clear that Seattle and San Francisco's experiences show that the level of a user charge is important. In the case of Seattle, a substantial decrease in the subscription rate did not occur until the large rate increases in 1986. Therefore, it

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[2] *Choices for Conservation*, Resource Conservation Committee, Washington, D.C., July, 1979;XXIII.

appears that there is a threshold below which user charges are not likely to provide an incentive for people to change their habits.

From the evidence presented above, it seems that user pay systems are an efficient way of eliciting an initial reduction in waste for disposal. The success of a user pay strategy depends on the success of other programs (e.g., recycling and provision of markets for secondary materials). These alternative programs absorb most materials diverted from disposal because of user charges.

A.1.3 Equity

User charges result in generators paying for the services they enjoy and avoid those who are waste conscious from subsidizing the profligate. Also, there is likely to be a correlation between income and waste generated so user charges are equitable from this standpoint too. However, the introduction of user charges may be regarded as inequitable if they result in a reduction in property taxes while imposing an increase in costs on the poor.

Another dimension of equity concerns the equal treatment of equals. Those in multiple unit dwellings are not likely to benefit the same way that those in single unit dwellings are, since user charges are difficult to implement in multi-unit dwellings.

A.1.4 Diversion potential

Given that consumers would have to pay for the amount of waste they disposed, it is expected that they would be more conscientious about waste management, and recycle and reuse more. Consumers are expected to increase their 3R's activities if user charges are implemented; begin to compost more yard and food waste (reduce); re-use certain items; and increase their recycling activities.

Based on the experience elsewhere, a pay-by-the-bag system implemented in Ontario at $1.50 for a large bag and $0.80 for a small bag, available to 80 per cent of the single-family units and duplexes and apartment dwellers, and also the IC&I Sector is assumed to perform as follows (Table A-1):

- The recycling rate for ONP (residential recovery) would increase 13 per cent and 18.5 per cent, for 1992 and 2000, in response to user charges.

- IC&I recycling rates for fine paper of 10 per cent and 30 per cent for 1992 and 2000 respectively would be achieved.

- Given the marketability of old corrugated cardboard (OCC), the IC&I recycling rates are anticipated to increase by 15 per cent by 1992 and 25 per cent by 2000. It is

Table A-1
User charges for waste management services diversion parameters

Waste components - residential sector	1992	2000
ONP	Recycling +13%	Recycling +18.5%
Old corrugated cardboard	Recycling +20%	Recycling +50%
Glass Containers	Recycling +11%	Recycling +12.4%
Plastics	Recycling +7.7%	Recycling +8.2%
Aluminium cans	Recycling +36%	Recycling +24%
Tinplate steel cans	Recycling +27%	Recycling +29%
Yard waste	Reduction +30%	Reduction +58%
Food waste	Reduction +13%	Reduction +21%
Disposable diapers	Reduction +18%	Reduction +33%

Assume: Pay-by-the-bag system - "large" and "small" bag rates set at $1.50 and $0.80 respectively.

Waste components - IC&I sector	1992	2000
Fine paper	Recycling +10%	Recycling +30%
Old corrugated cardboard	Recycling +15%	Recycling +25%
Glass containers	Recycling +12%	Recycling +7.8%
Aluminium cans	Recycling +7%	Recycling 22%
Food waste	Reduction +15%	Reduction +35%

expected the OCC would begin to be collected through municipal programs, resulting in recycling rates for the residential sector of 20 per cent and 50 per cent for 1992 and 2000 respectively.

- The projected residential recycling rates for glass containers are 11 per cent and 12.4 per cent respectively. It is expected that the IC&I sector will begin major recycling programs, recovering 12 per cent of glass in 1992 and a further 7.8 per cent in 2000.

- The recovery of plastic film will come on stream in the mid to late 1990's, which will lead to 15 per cent recovered, PET recovery rates have been revised upward to 50 per cent and 92 per cent, while HDPE, an increase of 14 per cent and 23 per cent are anticipated for 1992 and 2000 respectively. As markets for other RPC and film are developed, their response to user charges is anticipated to be an 7.7 per cent and 8.2 per cent increase for all plastics by 1992 and 2000 respectively.

- The recycling rate for residential aluminium cans and foil will increase by 36 per cent and 24 per cent for 1992 and 2000 respectively. IC&I recovery would begin to make an impact with an anticipated response of 7 per cent and 22 per cent for 1992 and 2000 respectively.

- The recycling rates for residential tinplate steel cans will increase by 27 per cent and 29 per cent for 1992 and 2000 respectively.

- There are projected reduction rates of 15 per cent and 20 per cent for yard waste (residential recovery). Based on previous studies, with the advent of user charges, households would turn to composting and some municipalities would provide yard waste collection (at a charge). Therefore, it is feasible that yard wastes will be reduced by 30 per cent and 58 per cent.

- As with yard wastes, composting food wastes is a viable diversion route. However, there is a constraint on the number of households which can actually compost. It is anticipated that single family dwellings and duplexes would have the highest participation, while a small proportion of multi-residential complexes would have composting programs. Given these constraints, diversion rates of food waste of 13 per cent and 21 per cent of residential generation are assumed. IC&I recovery (from restaurants and office cafeterias) would begin to make a significant impact. It is anticipated that diversion rates of 15 per cent and 35 per cent would be achieved by 1992 and 2000 respectively.

- Given the implementation of user charges, it is anticipated that consumers will shift their preferences to diaper services[3]. It is expected that disposable diapers would still have a share of the market as consumers would still use them when a diaper

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[3] Figures vary but the economics of diapers indicate that washing your own is cheaper than using diaper service, which is cheaper than buying disposable diapers (SWEAP 1990;14).

service was not available[4] or where disposable diapers are significantly more convenient (e.g. when travelling). Demographics also plays a key role in diversion rates. Given that Ontario's population is aging the reduced demand for disposable diapers also acts as a diversion from landfill and incineration. Therefore, it is assumed that reductions of 18 per cent and 33 per cent would take place in 1992 and 2000 respectively, for the residential sector.

A.2 Deposit systems for durable goods and reusable containers

Deposit charges are charges added to the price of a good at the point of purchase which are refunded upon the return (of the product). Beverage containers typically are the targets of deposit system legislation.

Ontario already has this type of system, and it applies to many kinds of beverage containers in the province (Marvin Shaffer 1990;14). Deposit systems are particularly well suited to those products that present particularly serious problems upon entering the solid waste stream, either because of their large contribution to the stream; their size, weight or composition; or their toxicity[5]. By placing a deposit on these types of products, consumers are given a financial incentive to return a product to a recycling depot, thereby preventing it from entering the solid waste disposal stream.

Deposit systems are also suitable for durable goods because of the difficulty in accurately measuring disposal costs for such items due to the time lag between purchase and disposal (Marvin Shaffer 1990;14). Deposits could be placed on durable items such as appliances, furniture, and automobiles.

It is anticipated that deposit systems would affect the following components of the waste stream:

- glass containers;
- plastics;
- aluminium cans; and
- tires.

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[4] It is more feasible for diaper services to operate in urban centres. In rural areas, most consumers are faced with the choice of disposable diapers or washing their own cloth diapers.

[5] Examples include batteries and smoke detectors, and spent containers from hazardous household products (VHB 1990:14).

A.2.1 Empirical studies

Deposits on beverage containers have proved successful in achieving several objectives:

- reduction of littering;
- reduction of quantity of urban waste;
- reduction of raw material consumption; and
- reduction of energy consumption (OECD 1981;28).

Deposit systems have been implemented in a number of different jurisdictions:

- Florida imposes a minimum deposit of 5 cents on every glass, plastic, metal or plastic coated container that is sold in the state. Products with a brand name permanently marked and that are subject to a minimum 10 cent deposit, or containers that meet the 50 per cent recycling target set by Florida are exempt from this deposit (Shrybman 1989).

- Saskatchewan imposes a deposit charge of 5 cents on aluminium cans and 10 cents on PET bottles. Depots have been set up throughout the province where individuals can return these containers to receive their deposit refund. Response to the deposit scheme has been better than the provincial Ministry of the Environment had anticipated, with approximately 70 per cent of the aluminium cans and 55 per cent of PET bottles being returned for recycling. Saskatchewan is considering adding non-refillable glass beverage containers to the tax/deposit system and if this proves successful, other glass containers as well (Marvin Shaffer 1990).

- An OECD study (1981;28) reports that the number of beverage containers littered per mile of road decreased from 127 to 43 per cent; beverage related litter fell from 30 per cent of total pieces to 11 per cent; measured by volume, beverage container litter declined from 43 per cent of total litter to 19 per cent. The OECD study does not report the level of deposit in each jurisdiction. Household solid waste is estimated to have decreased 4-5 per cent by weight. This suggests a decrease of some 80-90 per cent of the beverage containers entering the solid waste stream.

- Denmark requires that beer and carbonated soft drinks be sold in refillable bottles. A deposit (the level of the deposit is not given in the report) is collected on the sale of beverages to encourage returns, and the number of different bottles has been limited to simplify the return systems. An estimated 99 per cent of bottles are returned (OTA 1989;318).

- In Sweden, a deposit system exists for most glass bottles, including wine, beer and carbonated soft drinks. (the level of the deposit is not given in the report) is About 98 to 99 per cent of the beer and soft drink bottles and 75 per cent of the wine bottles are returned. Sweden also has a deposit system on aluminium cans, and over 75 per cent of such cans are recovered (OTA 1989;318).

- Ontario beer containers have consistently achieved return rates over 90 per cent, as have Becker's milk containers (Marvin Shaffer 1990).

Deposit systems are applicable to items other than beverage containers:

- Some states in the United States impose deposits on tires to help finance recycling and research on appropriate disposal methods. For example, Wisconsin imposes a $2 deposit on tires (OTA 1989;339).

- A deposit system on car hulks has been implemented in Sweden since 1976. A deposit of SKr 250 is levied on all manufactured and imported cars (vehicles under 1,800 kg only). This deposit is refunded in the form of a SKr 300 "scrapping premium", when the car owner delivers his used car to an authorized car scrapper. As of March, 1978, the fund had attained a level of SKr 71 million, and SKr 1.78 million have been paid to local authorities for financing the disposal of about 20,000 car hulks. (OECD 1981;29)

- A deposit-refund system has been in operation in Norway since May, 1978. A charge of NKr 450 is levied on all cars (automobiles and vans under 3,500 kg). When a car is delivered to a collection point, a sum of NKr 500 is refunded to the owner of the car (OECD 1981;29-30). The success of this program is unknown.

  Based on the initial favourable response of car-hulks, the use of similar deposit systems for other bulky durable goods such as refrigerators, freezers, and washing machines were being considered.

A.2.2 Efficiency

Deposit charges provide a direct financial incentive for re-use and recycling. The deposit systems outlined above for beverage containers have been successful at diverting these products from the solid waste stream. It is possible that a curbside recycling program may have been able to achieve similar results with less income and opportunity cost effects on consumers.

British Columbia's Ministry of the Environment (1988), in its review of it own deposit-refund system and of deposit systems in other jurisdiction, found them to be the most effective of all

measures with respect to reuse, recycling and avoidance of litter. The recovery rates for the deposit/refund system in British Columbia is 77 per cent (Marvin Shaffer 1990;60).

Deposit systems are sensitive to market conditions. Conditions favouring refillable bottles in Denmark and West Germany, however, are not necessarily present in the United States. For example, transportation of refillable bottles probably is less costly in Europe. Denmark only has 2 breweries, but is small and has a dense population. West Germany has hundreds of local breweries and extensive local distribution. In the United States, in contrast, the largest brewer has only 11 breweries for the entire country (OTA 1989;119).

A.2.3 Equity

Deposit charges should result in a more equitable distribution of the costs of solid waste management because they ensure that consumers are made to bear the costs of disposing of the products that they purchase. However, deposit charges may have negative real income effects, since they require that cash be tied up in a non-useful form, which are not so simply mitigated. Given that the return rate on (deposit-charged) beverage containers is less than 100 per cent, there is a transfer of income from consumers to deposit holders.

A.2.4 Diversion potential

Deposit charges are applicable in Ontario. It is anticipated that deposit systems would have a significant impact on a specific group of waste components. Given that consumers would have to pay deposits for certain items, it is expected that the incentive of a refund would persuade waste generators to be more conscientious about waste management.

If more exhaustive deposit systems are implemented, consumers would increase their 3R's activities. They would also begin to purchase more reusable items and increase their recycling activities. Given that these costs are borne by consumers, it is anticipated that the following adjustments would be observed (Table A-2):

- Food and beverage containers constitute 92 per cent (1989) of glass in the solid waste stream. Given the success of beer bottle returns in Ontario, a high re-use rate is feasible if a similar program is extended to other containers. However, the problems of non-standardized containers and Consumers Glass's recycling quotas may hamper the success of such a system. Given these constraints, it is anticipated that recycling will increase by 24 per cent and 37.6 per cent, while re-use rates of 15 per cent and 22.5 per cent for 1992 and 2000 respectively will be achieved. This would be the case for the residential and IC&I sectors.

Table A-2
Deposit systems for durable goods and reusable containers diversion parameters

Waste components - residential sector	1992	2000
Glass containers	Reuse +15% Recycling +24%	Reuse +22.5% Recycling +37.6%
Plastics	Recycling +1.3%	Recycling +1.8%
Aluminium cans	Recycling +36%	Recycling +29%
Tinplate steel cans	Recycling +10%	Recycling +10%
Tires	Recycling +6.5%	Recycling +8%

Waste components - IC&I sector	1992	2000
Glass containers	Reuse +15% Recycling +24%	Reuse +22.5% Recycling +37.6%
Tires	Recycling +6.5%	Recycling +8%

- Given Federal government regulations, plastics used for food storage cannot be re-used in a similar manner. It is anticipated that the implementation of a deposit system will enhance the recycling rates of plastics. It is also anticipated that recycling rates of 13 per cent and 18 per cent for 1992 and 2000 would be achieved for all plastics.

- With the advent of deposit systems, it is anticipated that recycling rates of aluminium will increase by 36 per cent and 29 per cent for 1992 and 2000 respectively.

- Given the imposition of deposit systems, it is expected that there will be a 10 per cent increase in recycling, for 1992 and 2000, of tinplate steel cans.

- Deposit systems on tires will result in higher rates of recycling. It must be noted that re-use of tires is a choice that will be determined by the general economic environment. Hence, it has been assumed that deposit systems will not influence a consumer's choice in their decision to re-use tires. Deposit systems would increase

the rate of recycling. It is anticipated that rates of recycling will increase by 6.5 per cent and 8 per cent for 1992 and 2000 respectively for both the residential and IC&I sectors.

A.3 Subsidized home composters

Composting is a process used to convert organic waste materials, both vegetable and animal, to a rich humus-like soil amendment used in gardening and agriculture. Composting is an aerobic decomposition process in which organic matter is naturally oxidized to simple chemical compounds with an accompanying release of heat, water vapour, and carbon dioxide (Dillon 1990;i).

Potential raw materials for composting include the compostable fraction of municipal solid waste - yard, garden and grass leaf waste, agricultural crop residues and animal manures, food processing wastes, forest products and paper production waste and other biodegradable wastes from industry and other sectors of society. The primary objective of composting is to recover and recycle a valuable resource in an economic and environmentally acceptable manner.

It is assumed that there will be a 100 per cent recovery of compostable material.

A.3.1 Empirical studies

There is very little literature on backyard composting. Most of the literature focuses on municipal programs and centralized composting facilities.

Ontario has taken a progressive stance with regard to backyard composting. Metro Toronto Works Department sold 12,000 backyard composters in 1990 to interested individuals at a quarter of the cost of producing a unit. Metro believes that the household composting program will pay for itself in five years by avoided collection and costs (Dillon 1990;4-1).

Environment Ontario has also approved the funding for more than 116,000 home composters (MOE 1990;1) to help 44 communities across the province issue home composting units to householders. The Ministry pays half the cost of the composter, with the local municipality and individual householder picking up the remainder. These composting projects will monitor the participation rates, the efficiency of the composting units, and the amount of waste diverted from landfill sites. The MOE commitment totalled $3 million in 1990.

Seattle also has a program of distributing home composting bins. However, no evaluation of this program could be found.

A.3.2 Efficiency

The quantity of food and yard wastes typically in the municipal solid waste stream in Ontario is about 32 per cent (CH2M Hill 1991). Backyard composting is regarded as one of the most effective ways for consumers to divert their waste from landfill. However, there are a number of constraints that would affect the efficiency and effectiveness of any home composting program.

The main constraint facing any composting program are spatial requirements. Most backyard composting is limited to single family residences.(Dillon 1990;2-22).

There are a number of pilot projects being conducted by the Metro Toronto Works Department which assess the feasibility of composting for housing co-operatives and apartments. It is anticipated that these projects provide useful models for future composting projects.

A.3.3 Equity

A flat subsidy for backyard composters is likely to be of more benefit to those with lower incomes than those with higher incomes, providing both groups take advantage of the scheme. If the subsidy is too small, it is possible that a disproportionate number of higher income households will benefit from the subsidy.

Since backyard composters are most suitable for single family dwellings, those who live in apartments will be disadvantaged unless a separate program is developed for them.

A.3.4 Diversion potential

Within the next few years, there will be an estimated 116,000 subsidized home composters in operation in Ontario. It addition, there is an unknown number of composters in use that people build or purchase themselves.

The effectiveness of the composters is only limited by consumer dedication in using the composter since home composting can demand considerable effort on the part of the home owner, and must compete with other demands for time (Dillon 1990;2-22).

There are a number of constraints facing such a program:

- the number of composters in operation; and
- the target group.

It is assumed that there will already be 116,000 subsidized composters in operation by 1992 (plus build-your-own and directly purchased composters). Assuming that apartment buildings are not part of this program, there will be an estimated 2,873,516 "eligible" households in 1992, and 3,223,670 households in 2000.[6] It is assumed that 160,000 and 300,000 households would have composters in operation by 1992 and 2000, respectively, in response to this program. Assuming an average of 2.7 persons per household, one household would divert approximately 360 kg (175 kg food waste, 185 kg yard waste) of solid waste. This would translate into the reduction of 4.3 per cent of both food and yard waste in 1992, and 7.5 per cent in 2000, over the current trend (Table A-3).

Table A-3
Subsidized home composters diversion parameters

Waste components - residential sector	1992	2000
Yard waste	Reduction +4.3%	Reduction +7.5%
Food waste	Reduction +4.3%	Reduction +7.5%

A.3.5 Implementation costs

Table A-4 presents the anticipated cost of expanding the home composters program in the Province. Implementation costs are assumed equal to a subsidy of 100 per cent of the purchase price of the composter, $72 (1989$). It is anticipated that 44,000 new home composters will be provided in 1992 and 96,000 in 2000 at a discounted cost of $9.78 per annum (1989$) per composter (discount rate 6 per cent, life 10 years). The estimated total implementation cost of the home composters program is $430,000 (1989$) in 1992 and $1.4 million (1989$) in 2000.

6 Statistics Canada, Cansim D845819 and D846023. "Eligible" households include: detached, single detached (semi-double and row) and multiple 2, 3 and 4 units.

Table A-4
Cost of subsidised home composters

Annualized cost of measure, 000's (1989$)		
CAPITAL COSTS	**1992**	**2000**
Approvals/Hearings	$0	$0
Site Acquisition	$0	$0
Equipment	$430	$1,370
Total Capital Costs	$430	$1,370
OPERATING COSTS		
Labour	$0	$0
Maintenance	$0	$0
Energy	$0	$0
Administration	$0	$0
Total Operating Costs	$0	$0
TOTAL COST	$430	$1,370

Source:
Biocycle, December 1990:70.

Note: Costs estimated as follows:

Subsidy:	100%
Cost per home composter:	$72 (1989$)
Discount rate:	6%
Life:	10 years

Annualized cost/composter: $9.78 (1989$)/a

Increase in number of composters over the current trend (WMPM):

Year	**Number of composters**	**Waste diverted (t/a)**
1992	44,000	47,743
2000	140,000	61,680

A.4 Landfill tipping fees

Tipping fees are charges imposed upon users of landfill facilities. Where tipping fees are paid by private waste haulers the ultimate impact is on the waste generator, since waste haulers transfer the burden of the fee back to their customers (VHB 1991). Therefore, tipping fees can provide an indirect method of ensuring that waste generators pay the full cost of the disposal of their wastes. Given that a large proportion of IC&I waste generators in Ontario use private waste haulers, increased tipping fees can provide a financial incentive for waste reduction if generators begin to explore other avenues for dealing with their wastes other than landfill.

Tipping fees are one means of providing the IC&I sector with an incentive for waste reduction and greater recycling. Their impacts will be negligible upon the residential sector.

Where the disposal site is privately owned or is the responsibility of the area municipality, the local municipality is typically charged a fee. In some cases such as the case of Metropolitan Toronto, the charge is not based on weight or volume, so that there is no immediate cost incentive for the municipality to reduce its disposal quantity. (VHB 1991).

A.4.1 Empirical studies

The use of tipping fees has the potential for providing an incentive for waste reduction for IC&I generators. There are two ways of modifying the tipping fees structure to create an incentive for waste diversion:

- surcharges; and
- differential fees.

Surcharges

Surcharges are costs charged beyond normal tipping fees. There are two types of surcharges, those collected for the State or Province and those collected for the host municipality.

There are number of examples of existing surcharges applied to tipping fees (VHB 1991):

- In 1988, Pennsylvania enacted the Municipal Waste Planning, Recycling and Waste Reduction Act, requiring the collection of a tipping fees surcharge by the operators of all municipal landfills and resource recovery facilities. The surcharge is a "recycling fee" of $2 U.S per ton of solid waste received at the facility. The revenue

generated from the surcharge is used by municipalities to fund waste management initiatives, feasibility studies for municipal waste processing and disposal facilities, and public education, information, and technical assistance programs concerning litter control, recycling and waste reduction. There is no information on the success of this program.

- The British Columbia Ministry of the Environment proposed in a provincial discussion paper that the province collect a tipping fees surcharge of $1 to $3 (1989 $) per tonne of waste collected at all landfills in the province. The surcharge was expected to generate $1.5 to $6.6 million annually which would be used to fund solid waste programs proposed in the discussion paper. After much debate, the surcharge was lowered to $0.50 per tonne. No data regarding the effectiveness of this program are available.

- New Jersey has had a system of surcharges on tipping fees dating back to 1970. The state collects a wide variety of surcharges, which are typically redistributed to counties, municipalities and private businesses to fund programs dealing with solid waste management. Examples of the types of surcharges collected are as follows:

    - Solid Waste Services Tax ($0.75 per ton) used by counties to fund solid waste management plans;
    - Solid Waste Recycling Tax ($1.50 per ton) used by counties and municipalities to fund recycling programs; and
    - Resource Recovery Investment Tax ($4.00 per ton) used to offset the higher cost of sending waste to resource recovery facilities, as well as to fund planning and construction of sanitary landfills. From literature reviewed, there have been no assessments of the effectiveness of New Jersey's program.

Differential fees

Differential tipping fees vary with certain criteria relating to the type of waste disposed. For example, higher tipping fees are charged for waste containing material easily recycled in an existing recycling program than for waste from which all recyclable materials are removed.

The only example of differential tipping fees found in the literature is in Rhode Island:

- Rhode Island, because it is such a small land mass, is able to operate one, main landfill-site, which accepts approximately 80 per cent of the State's solid waste. The site is owned and operated by a government organization known as the Rhode Island Solid Waste Management Corporation (SWMC). The SWMC charges tipping fees of $13 per ton for municipal waste and $59 per ton for commercial waste. However,

each municipality is charged a tipping fee of $13 per ton for waste disposal only until it has sent a predetermined tonnage to the central landfill. Municipalities are charged the commercial fee of $59 per ton for any subsequent waste shipped to the landfill during the remainder of the year (VHB 1991).

An unfortunate effect of the high commercial tipping fees in Rhode Island is that some commercial and industrial waste generators now ship their waste to Massachusetts where tipping fees are lower. There are no data on the effectiveness of this program.

The only evidence to suggest that tipping fees are an effective method of waste diversion is in Seattle, Washington, where in combination with a user charge system, tipping fees were found to provide an incentive for reduction for municipal customers. Evidence to support this assertion is provided by the cause and effect relationship between the rapid rise in tipping fees and the ensuing decrease in average household waste disposal (VHB 1991).

In Metro Toronto, to utilize the waste deterrent effect of tipping fees, the Metro Works Commissioner has recommended that charges payable by private haulers be increased to $150 in 1991. The Regions of Peel and Halton set their 1989 tipping fees within the same range. Since 1989, tipping fees in the Greater Toronto Area have risen even further.

A.4.2 Efficiency

Surcharges and differential tipping fees could provide municipalities and the IC&I sector with an incentive to consider alternative methods of waste management prior to sending their wastes to landfill. The incentive for the IC&I sector is more direct given they pay the full cost for waste management. Municipalities, to abate increasing landfill costs, would typically look towards residential programs (for example: enhanced *Blue Box* collection, yard waste collection) as a means of waste reduction.

Since these are primarily a means of financing the costs of disposal, their efficiency is similar to that of a user charge, since costs are passed on to the waste generator.

A.4.3 Equity

Tipping fees provide a means of improving the equity of solid waste management by ensuring that landfill customers pay the appropriate share of the costs of landfill operations. Differential tipping fees can result in greater equity than single fee structures. Since differential fees can be adapted to meet the wide variety of wastes, with the corresponding variety of disposal costs, that may be accepted at landfill sites. Customers pay a price that more closely reflects the costs of dealing with the specific waste they generate.

A.4.4 Diversion potential

Landfill tipping fees only directly affect waste coming from the IC&I sector. It is anticipated that the IC&I sector will increase their recycling efforts as a result of higher tipping fees.

Based on the landfill tipping fees structures assessed, it is assumed that a differential tipping fees schedule will be implemented in Ontario. It is expected that the fees will be set on the proportion of recyclable materials present in the waste that is sent for disposal at a landfill. It is anticipated that these differential fees will be applied universally to all landfills in Ontario.

Given that these increased disposal fees will be borne by the IC&I sector, the anticipated diversion rates for the IC&I sector are as follows (Table A-5):

- It is anticipated with the imposition of differential tipping fees that the recycling rates for ONP will increase by 5 per cent and 10 per cent for 1992 and 2000 respectively.

- The IC&I recycling rates for fine paper are projected to increase by 10 per cent and 20 per cent for 1992 and 2000 respectively with the onset of differential tipping fees.

- Given that markets exist to absorb all OCC available, it is anticipated that IC&I recovery will increase to 20 per cent and 25 per cent for 1992 and 2000 respectively.

- With the advent of differential tipping fees recycling of telephone books from the IC&I sector is anticipated to improve by 5 per cent and 7 per cent for 1992 and 2000 respectively.

- With an enhanced waste recycling initiative, it is expected that recycling of glass containers from the IC&I sector will improve by 5 per cent and 8 per cent in 1992 and 2000 respectively.

- Given the inertia in the markets for recycling plastics, the following improvements have been anticipated: (i) for 1992, there will be a 10 per cent across the board increase in recovery of PET, HDPE and other RPC; (ii) for 2000, for these three items, there will be a 15 per cent increase in recovery, while there a 10 per cent improvement in the recovery of film will be realized. The result of the imposition of differential tipping fees will be a 4.4 per cent and 12.2 per cent increase in the recycling of plastics for 1992 and 2000 respectively.

- Given well developed markets for secondary aluminium, recycling efforts will improve the recovery of this material to 8 per cent and 12 per cent for 1992 and 2000 respectively.

Table A-5
Landfill tipping fees diversion parameters

Waste components - IC&I sector	1992	2000
ONP	Recycling +5%	Recycling +10%
Fine paper	Recycling +10%	Recycling +20%
Old corrugated cardboard	Recycling +20%	Recycling +25%
Telephone books	Recycling +5%	Recycling +7%
Glass containers	Recycling +5%	Recycling +8%
Plastics	Recycling +4.4%	Recycling +12.2%
Aluminium cans	Recycling +8%	Recycling +12%
Tinplate steel cans	Recycling +3%	Recycling +5%
Food waste	Reduction +5%	Reduction +14%
Wood waste	Recycling +10%	Recycling +15%
Disposable diapers	Reduction +10%	Reduction +14%
Drywall (Construct/Demo)	Recycling +4%	Recycling +7%
Tires	Recycling +3% Reuse +2%	Recycling +5% Reuse +3%
Foundry sand	Reduction +2%	Reduction +7%
Other	Reduction +5%	Reduction +5%

- There will only be a minimal recovery of tinplate steel cans from the IC&I sector in years to come. With the imposition of differential tipping fees, recycling of this material will improve by 3 per cent and 5 per cent for 1992 and 2000 respectively.

- The projected recovery rates for food waste are negligible. With options such as "swilling", it is anticipated that food waste will be recovered at rates of 5 per cent and 14 per cent for 1992 and 2000 respectively.

- Given that wood is an easily recyclable material, it is expected that recycling will improve by 10 per cent and 15 per cent for the same years.

- With the imposition of differential tipping fees it is anticipated that the recycling of construction and demolition wastes will improve by 4 per cent and 7 per cent for each of the target years.

- Differential tipping fees will likely influence industry to re-use 2 per cent and 3 per cent of all IC&I tires, and increase recycling by 3 per cent and 5 per cent, for each of the target years.

- Tipping fees initiatives will promote more recycling of foundry sand increasing reduction rates by 2 per cent and 7 per cent for the same years.

- Tipping fees are expected to reduce *Other* waste generation by 5 per cent in both years

A.5 Yard and organic waste collection programs

Yard and organic waste collection programs typically involve municipal composting programs. Composting of this magnitude has gained favour as a municipal solid waste management method because it can divert organic materials from landfills and reduce the risks associated will landfill and incineration (OTA 1989;184). It is estimated that with ideal conditions, composting can occur rapidly, yield a marketable product, and reduce the original volume of materials by more than 50 per cent (OTA 1990;184). This provides motivation for municipalities, who face landfill constraints, to attempt such strategies.

A.5.1 Empirical studies

There are numerous examples of yard and organic collection programs, which have been implemented in conjunction with municipal composting:

- Mandatory source separation of yard waste from residential solid waste became law in Seattle, Washington, in 1989. Customers of the Seattle Waste Utility (SWU) may request weekly or biweekly curbside collection of organic waste; or customers may haul organic wastes to one the City's transfer stations. The yard waste program has been extremely successful.

  The combination of curbside and self-hauled organic wastes was 46 per cent higher in 1989 than the SWU predicted, and represented 73 per cent of the 1990 diversion goal. The curbside program was particularly successful, reaching 93 per cent of the 1990 diversion goal in the first year; self-haul was not as popular, reaching only 55 per cent of the 1990 diversion goal.

- Yard waste facilities are relatively commonplace across the United States: New Jersey has 180 leaf composting facilities; and Massachusetts has about 25 per cent of all municipalities participating in yard waste composting programs (OTA 1989;188).

- In the United States, a few facilities which compost only food waste are in operation. Examples of such facilities include an operation in Virginia which collects waste grease, bones, fat and offal from slaughterhouses, restaurants, and supermarkets and processes it into animal feed additive; and, in New Jersey, some farmers are licensed to collect food wastes for feed to hogs (OTA 1990;189).

- The composting of yard and food waste that is separated from other MSW is increasing in Europe (OTA 1990;188-189). In West Germany, approximately 70 organic source separation projects exist. It is estimated that these programs serve 430,000 households, and compost approximately 91 kg of organic waste per person.

- Several Ontario municipalities have successfully implemented residential yard waste collection and composting programs. Of these programs, operations in Waterloo and Guelph have been the most effective. It is estimated that in 1989, about 3 per cent of all organic waste in Ontario was collected through municipal composting programs (RIS 1991).

- William Neilson Limited of Toronto, which creates large quantities of food waste in its manufacturing process, has an arrangement with a pig farmer, who takes this waste away for processing into animal feed (SWEAP Summer 1990;7).

A.5.2 Efficiency

Yard and organic waste collection programs provide a direct financial incentive to the IC&I sector for waste diversion. Given that most IC&I waste collection is user charge based, it is anticipated that any mechanism provided to divert waste, at a cost lower than standard collection, will be utilized.

The residential sector is slightly different. The success of any residential yard and organic waste collection program is based on other programs already in place, which also divert waste. For example in Seattle, an extensive user charge system already exists, and rates for yard waste collection are less than regular household waste. Given this, its quick start-up, low cost, and convenience, Seattle's program is highly successful.

A.5.3 Equity

The are many benefits to yard and organic waste collection programs. Municipalities would save from reduced landfill costs, while they may save and/or earn money from the use of composting. Any cost saving may be transferred to the public in the form of lower waste management taxes. The IC&I sector would benefit by saving in waste management costs. Through "swilling" some hog farmers may obtain feed for their swine at a lower cost.

A.5.4 Diversion potential

Based on 1989 estimates, organics currently comprise about 32 per cent of the residential waste stream (food and yard waste), and between 5 per cent and 3 per cent of IC&I waste (CH2M Hill 1991;Tables 3.3 and 3.9). Given these significant quantities, municipalities find it attractive to focus programs exclusively on collection of these materials, as a means of waste diversion.

Current trends indicate that there is a move towards banning yard waste from all landfills. As a result, various municipalities have moved towards separate and/or specific yard waste collection, primarily from the residential sector.[7]

Given the initial success and the effectiveness of current yard and organic waste collection programs, the potential for enhancing and developing more programs is favourable. A number of programs which could successfully divert wastes in the province are already under way or planned (RIS 1991):

- The establishment of a yard and organic, large 25,000 to 30,000 hog farm in the Greater Toronto Area, to consume food waste from the region's largest generators.
- Metro Toronto recently doubled its quantity of composted leaves from 6,000 tonnes/a to 12,000 tonnes/a. Plans exist to compost 60,000 t/a of leaves by 1992.
- In 1988, Metro Toronto approved the preliminary design for a 190 tonnes per day composting plant for selected organic food waste from industry (Metropolitan Toronto Commissioner of Works 1990).

Given the potential of yard and organic waste collection programs, the following increases in waste diversion through expanded yard and organic waste collection are anticipated (Table A-6):

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[7] For example, The Municipality of Metropolitan Toronto, 1990, *How to Bundle up for Spring.*

Table A-6
Yard and organic waste collection programs diversion parameters

Waste components - residential sector	1992	2000
Yard waste	Reduction +25%	Reduction +60%

Waste components - IC&I sector	1992	2000
Yard waste	Reduction +10%	Reduction +25%
Food waste	Reduction +8%	Reduction +20%

- Assuming that yard waste programs are instituted independently of other waste management initiatives, it is anticipated that an additional 25 per cent and 60 per cent of residential yard waste will be diverted through municipal composting for the respective target years.

- Recovery programs for IC&I yard and organic wastes are virtually non-existent. Given current projections, it is anticipated that this will continue . However, with the advent of collection programs and their ensuing implementation time and coverage, it is expected that 10 per cent of yard waste and 8 per cent of food waste will be diverted in 1992. Similarly for the year 2000, an additional 25 per cent of IC&I yard waste and 20 per cent of food waste are anticipated to be diverted.

A.5.5 Implementation costs

Table A-7 presents the estimated cost of implementing a yard and organic waste collection program for the Province. The estimated costs are about $5 million in 1992 and about $7.9 million in 2000 for developing up to four composting facilities excluding collection costs.

Table A-7
Cost of funding yard and organic waste collection programs

Annualized cost of measure, 000's (1989$)		
CAPITAL COSTS	**1992**	**2000**
Approvals/Hearings	na	na
Site Acquisition	na	na
Equipment	na	na
Total Capital Costs	$936	$1,482
OPERATING COSTS		
Labour	na	na
Maintenance	na	na
Energy	na	na
Administration	na	na
Total Operating Costs	$4,051	$6,413
TOTAL COST	$4,987	$7,895

Sources:
M.M. Dillon Limited. 1990.

Note: The cost of yard and organic waste collection composting facility is based on the following assumptions:

Facility size	70,267 t/a	**Cost of waste received (1989$/t)**	
Discount rate	6 %	Capital costs	$5.92 /t
Life	20 years	Operating	$25.63 /t

	Estimated waste diverted (WMPM)	Number of composting facilities required
1992	158,031 t/a	2.25 facilities
2000	250,140 t/a	3.56 facilities

Capital costs are assumed evenly distributed between site acquisition and equipment purchases; operating costs are also evenly distributed. Collection costs are excluded.

na - not available

A.6 Education programs

Through various programs which are used to educate the public and industry, compliance with, and participation in waste management programs will increase. As such, education is an indirect means through which increased waste diversion can occur.

Education programs typically revolve around the distribution of pamphlets, grade-school curricula and public service announcements. Ontario currently has in place a number of education programs geared towards the residential and IC&I sector[8]. From Canada's *Green Plan*, the Federal government is committed to provide information to individuals and businesses through new and ongoing programs.

The ultimate goal of education programs is to alter consumer's choices. It is hoped that through these programs that consumers and industry will decide to use less packaged goods, purchase and reuse more durable items, purchase more deposit items and less single-use (disposable) items, recycle, and compost more yard and food waste.

A.6.1 Empirical studies

United States

Rhode Island has instigated education programs at all levels, from grade to graduate school, focusing on both consumers and industrial waste diversion. The Rhode Island Department of Environmental Management has published books on waste management, including waste reduction, and has held workshops on the topic. A task force provides technical assistance to IC&I establishments, including guidance documents, training and certification of waste auditors, and design and specification of equipment and services (OTA 1990;316).

In 1976, extensive education programs were undertaken in Marblehead and Somerville, Massachusetts. In both communities, a letter was sent to each household explaining the importance of glass recycling and how they can participate in municipal programs. A follow-up telephone survey showed that the letter was received and read by 80 per cent and 69 per cent of the residents of Marblehead and Somerville, respectively. Information on the recycling schemes in the two communities was presented through posters, articles and advertisements in local and regional newspapers and, to a lesser extent, through television and radio. It is estimated that the participation rates were 75-80 per cent in Marblehead and 17-23 per cent in Somerville (OECD 1983;67-69).

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[8] For example, the Ministry of the Environment regularly publishes *FACTS* and *Environment Information* and have also put out a package on *The Industrial Waste Diversion Program*. There is also an extensive advertising campaign to encourage individuals to recycle more of their waste.

Switzerland

Vetrorecycling S.A. (national organizer for recycling operations) distributed an explanatory leaflet to all parties interested in glass recycling. The leaflet described alternative transport and collection systems, detailed the prices paid for waste glass and the destination for different colours of glass, and identified the contaminants that should be excluded. Across Switzerland, participation rates were estimated at between 50 per cent and 80 per cent (OECD 1983;66-67).

Germany

In the early 1970's, on a national scale, press releases, press conferences and instructive leaflets were used to promote the separation of glass by consumers. Information on the recycling scheme was distributed to groups such as local community organizations and schools. Areas where this was the only means of communication, participation rates varied between 13 per cent and 21 per cent. Konstanz, where there was an enhanced education program, participation was about 50 per cent (OECD 1983;67-68).

Netherlands

In North Brabant, education programs were devised by a committee comprising representatives of central and local government, industry and consumers. Information on the glass recycling scheme was presented through posters, stickers on glass collection containers and explanatory leaflets. The scheme was advertised in the local press. Participation in this program was estimated to be in the range of 24 per cent to 34 per cent (OECD 1983;67,69).

Austria

In Vienna, households were sent a brochure explaining the need to recycle materials and informing them of how to participate in recycling glass containers. In addition, the recycling scheme was publicised frequently in the press, and on television and radio. Within Vienna, the program was quite successful achieving participation rates from 76 per cent to 87 per cent. However, the program at the national level elicited a participation rate in the range 25 per cent to 30 per cent (OECD 1983;67,70).

Ontario

In 1989, Metropolitan Toronto Council approved, in principle, a $3.1 million public education program to educate residents and businesses about the garbage crisis and to outline ways in which they could help to reduce waste. In 1990, Metro Council approved a one-year $2.6

million mass public education program focusing on waste reduction which would be implemented across the Greater Toronto Area (Commissioner of Works to Metro Works Committee 1990;Memo). No documented information on the effectiveness of this program is available.

At the provincial level, the government is committed to a goal of "promoting awareness of responsible waste management through public information and education" (MOE2 1990;13). These programs are directed at the residential and IC&I sectors. The approach to the residential sector is a relatively passive one; through the school system and various pamphlets, and advertising. The most developed residential program is the *Municipal Reduction/Reuse Program,* whose goal is to "promote greater awareness of buying habits and products that will reduce waste reduction rates" (MOE 1990;Environment Information).

However, in the IC&I sector, the approach is more aggressive, and grants are available to those in the IC&I sector for initiatives that promote the 3R's were significantly greater than those available to municipalities[9]. There is no monitoring of the effectiveness of these education programs.

A.6.2 Efficiency

It is difficult to assess the extent to which education programs are successful in diverting waste from landfill and incineration. Assuming the information collected from the OECD (1983) study is accurate, the potential for education programs is significant. It should be noted that the effectiveness of these programs is measured by their participation rates and how many glass containers were recovered.

From the literature reviewed, education programs provide an impetus for waste generators to participate in waste diversion programs. Therefore, they are useful in providing an initial "spark".

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9 Over the 1989-90 fiscal year, grants to the *Industrial 3R's* program totalled \$6.5 million, while grants to the *Municipal Waste Reduction/Reuse* program was \$0.13 million. For the 1990-91 period, funds allocated to the same programs totalled \$14.2 million and \$1.4 million respectively (Ontario Ministry of the Environment. 1990. *Highlights and Trends, 1990-91 Estimates.*).

A.6.3 Equity

Education programs are usually paid for from general revenues and, therefore, their funding is as equitable as the tax system. The benefits of education programs are normally available to all, though care should be given to providing material that is appropriate for people of all educational levels and ethnic backgrounds.

A.6.4 Diversion Potential

Assuming that education programs are the sole means of waste diversion, it is anticipated that they will have a limited impact. However, given the nature of these programs, they are complementary to most other waste diversion measures. Therefore, the effectiveness of education programs would be enhanced if they were implemented in conjunction with other waste diversion measures.

It is anticipated that the following adjustments from the current trend will be observed as a result of new and improved education programs (Table A-8 and Table A-9):

- For ONP recycling, an 8 per cent increase will be realized in the residential sector in both target years. The IC&I will see an increase in ONP recycling of 2 per cent and 5 per cent for 1992 and 2000 respectively.

- Education programs will encourage households to recycle fine paper at rates of 5 per cent and 7 per cent in 1992 and 2000. These same programs will increase IC&I recovery by 5 per cent and 10 per cent for the same time frame.

- As markets for recycling boxboard come on stream, recycling rates will increase by 3 per cent and 8 per cent in the residential sector, and by 3 per cent and 5 per cent in the IC&I sector, for 1992 and 2000.

- Given the current demand for old corrugated cardboard, education programs will encourage households to take the initiative and recycle an additional 5 per cent and 8 per cent more of this waste. The IC&I sector, which currently recycles some of this waste, will enhance through education programs current recycling by 10 per cent for 1992 and 2000.

- Education will increase the recycling of magazines, in the residential sector by 6 per cent and 7 per cent in 1992 and 2000 respectively.

- The recycling of telephone books will rise by 5 per cent and 6 per cent for the residential sector and by 2.5 per cent and 3 per cent in the IC&I sector for the target years.

Table A-8
Education programs residential sector diversion parameters

Waste components - residential sector	1992	2000
ONP	Recycling +8%	Recycling +8%
Fine paper	Recycling +5%	Recycling +7%
Boxboard	Recycling +3%	Recycling +8%
Old corrugated cardboard	Recycling +5%	Recycling +8%
Magazines	Recycling +6%	Recycling +7%
Telephone books	Recycling +5%	Recycling +6%
Glass containers	Recycling +5%	Recycling +5%
Plastics	Recycling +8%	Recycling +14.5%
Aluminium cans	Recycling +6%	Recycling +9%
Tinplate steel cans	Recycling +7%	Recycling +9%
Yard waste	Reduction +6%	Reduction +6%
Food waste	Reduction +5%	Reduction +6%
Tires	Reuse +2%	Reuse +2%
Disposable diapers	Reduction +8%	Reduction +8%
Other	Reduction +6%	Reduction +4%

- Glass containers will be recycled at higher rates due to education programs rising by 5 per cent in both years for the residential sector and by 3 per cent and 5 per cent in the IC&I sector for the target years.

- The recycling of plastics will rise by 8 per cent and 14.5 per cent for the residential sector and by 5.8 per cent in both years for the IC&I sector.

- More aluminum cans will be recycled with increases of 6 per cent and 9 per cent for the residential sector and of 2 per cent and 3 per cent in the IC&I sector for the target years.

- Like aluminum cans, the rate of recycling tinplate steel cans is also expected to rise as a result of education programs. The recycling of steel cans will rise by 7 per cent

Table A-9
Education programs IC&I diversion parameters

Waste components - IC&I sector	1992	2000
ONP	Recycling +2%	Recycling +5%
Fine paper	Recycling +5%	Recycling +10%
Boxboard	Recycling +3%	Recycling +5%
Old corrugated cardboard	Recycling +10%	Recycling +10%
Telephone books	Recycling +2.5%	Recycling +3%
Glass containers	Recycling +3%	Recycling +5%
Plastics	Recycling +5.8%	Recycling +5.8%
Aluminium cans	Recycling +2%	Recycling +4%
Tinplate steel cans	Recycling +3%	Recycling +5%
Yard waste	Reduction +2%	Reduction +3%
Food waste	Reduction +4%	Reduction +6%
Wood waste	Recycling +4%	Recycling +3%
Tires	Reuse +2% Recycling +3%	Reuse +2% Recycling +3%
Disposable diapers	Reduction +5%	Reduction +4%
Other	Reduction +6%	Reduction +4%

and 9 per cent for the residential sector and by 3 per cent and 5 per cent in the IC&I sector for the target years.

- More yard waste will be diverted. It is expected that increases of 6 per cent for both years in the diversion of yard wastes from the residential sector will occur. The amount of waste diverted from the IC&I sector will be less, 2 per cent and 3 per cent the target years.

- Food wastes from the residential sector will be reduced by 5 per cent and 6 per cent for the years 1992 and 2000. In the IC&I sector food wastes will be reduced by 4 per cent and 6 per cent for the target years as a result of education programs.

- Tires in the residential sector will be diverted through reuse by 2 per cent in each year. The increase in the rate of reuse in the IC&I sector will also be 2 per cent, in addition to increases in the rates of recycling of 3 per cent for 1992 and 2000.

- The diversion of disposable diapers will rise by 8 per cent for the residential sector and by 5 per cent and 4 per cent in the IC&I sector for the target years.

- Wood waste will be diverted in the IC&I sector increasing by 4 per cent in 1992 and 3 per cent in 2000.

- Education will increase source reduction of other wastes in the residential and IC&I sectors by 6 per cent and 4 per cent in 1992 and 2000, respectively.

A.6.5 Implementation costs

Table A-10 presents the estimated implementation costs of education programs which encourage waste diversion. The costs of the programs are estimated assuming an expenditure of $5 per household in each of the target years. This represents a doubling of existing expenditures on education programs (State of Washington 1990). The additional cost of education programs in 1992 is about $14 million and in 2000, about $16 million.

A.7 Virgin material taxes

Programs which stimulate or subsidize the development of natural resources have long been criticized by many conservationists and environmentalists. The basic argument is that subsidizing the cost of virgin raw materials has hindered the growth of secondary materials markets (Franklin 1988;1)[10]. If these concessions were removed and virgin material taxes put in place, the development of secondary materials markets would be encouraged instead of hindered.

The objective of virgin material taxes is to alter the use of virgin materials by substituting secondary materials for virgin materials, by increasing the relative price of virgin materials.

A virgin material tax can generate revenues for municipalities (Miedema 1976;1-2). Through consumer responses, and with the support of other programs to promote the use of secondary

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[10] For example, depletion allowances for mineral mining and petroleum have affected the development of and the markets for recovered steel, glass, aluminium, copper, plastics and re-refined oil see, Franklin (1990:1-2).

Table A-10
Cost of funding education programs

Annualized cost of measure, 000's (1989$)		
CAPITAL COSTS	**1992**	**2000**
Approvals/Hearings	na	na
Site Acquisition	na	na
Equipment	na	na
Total Capital Costs	na	na
OPERATING COSTS		
Labour	na	na
Maintenance	na	na
Energy	na	na
Administration	na	na
Total Operating Costs	na	na
TOTAL COST	$14,368	$16,118

Sources:

Statistics Canada, Cansim single and semi-detached homes database.

Note:

Education expenditures are calculated on a per household basis.

Year	Number of households
1992	2,873,516
2000	3,223,670

Program expenditures per household are assumed to equal $5 (1989$). Costs are annual. A detailed breakdown of costs by type of expenditure depends on the education strategy implemented.

na - not available

materials, industries will shift towards greater secondary material recovery and use.

A virgin material taxes are levied only against those materials that can be recycled. They would affect the following components of the waste stream:

- ONP;
- fine paper;
- boxboard;
- old corrugated cardboard;
- glass containers;
- aluminium cans and foil; and
- tinplate steel cans.

A.7.1 Empirical studies

From the literature reviewed, no specific example of the use of virgin material taxes on recyclable materials could be found. In West Germany, taxes applied to lubricating oils serve a function similar to virgin materials taxes. A number of studies which analyze the potential effects of virgin material tax have been conducted.

West Germany

Since 1969, a system of taxing virgin mineral lubrication oils in West Germany has been in place. The objective of the tax is the safe disposal of waste oil, either through recycling or non-polluting treatment.

The tax is paid by manufacturers or importers of mineral lubrication oils, and on reprocessed oil. The revenue collected is placed into a 'Reserve Fund for Ensuring the Safe Disposal of Waste Oil'. These funds are redistributed in the form of aid to firms which agree to collect and re-process, or dispose in a non-polluting manner, the waste oil.

In 1976, the tax was equivalent to DM 0.81 per litre of waste oil.

Since the tax was introduced, the quantity of waste oil handled through the Reserve Fund has doubled, even though the amount of waste oil remained the same. The volume of monitored waste oil disposal dropped form 92,000 tonnes to 9,000 tonnes, a 90 per cent decline (OECD 1981;18-20).

Feasibility studies

In an evaluation of the paper industry (Miedema 1976), virgin and secondary fibre consumption effects based on charge/subsidy policy options, as predicted through a charge/subsidy model were analyzed. Charges or virgin materials taxes, were assessed on a per ton basis for a variety of recyclable waste materials. The analysis predicted that for 1985, assuming a $25 tax rate, consumption of secondary fibres would increase by 96 per cent, while virgin fibre demand would decline by 24 per cent (Miedema 1976) .

The effects of federal subsidies on materials recycling has also been examined by the Environmental Law Institute. Using an econometric approach, the effects of recycling of secondary materials with subsidy elimination were analyzed concluding that tax benefits for mining and timber growing are substantial but do not significantly discourage or reduce the use of secondary materials (Franklin, 1988:12). The estimated effect in the United States of virgin material subsidies on virgin paper products was a one per cent increase in price, for aluminum, prices were five per cent higher; and for steel, two per cent higher.

A.7.2 Efficiency

The West German case provides an indication of the effectiveness of virgin material taxes. Given the mechanisms by which waste oil is collected (i.e. through industrial users and service stations), it is not surprising that this program was successful.

However, for the waste components identified for this study, the anticipated response to virgin material taxes is expected to be weaker - compare the concentrated method of collection for waste oil versus *Blue Box* and other source separation programs for potentially affected waste components.

Virgin material taxes provide a direct incentive for the greater use of secondary materials. For certain manufacturers, the advent of the tax would provide the impetus to alter manufacturing processes and to facilitate the use of secondary materials. This will promote greater waste diversion from landfill and incineration.

A.7.3 Equity

Each manufacturer pays for the use of virgin materials, and some portion of the cost is typically passed on to the consumer with a virgin material tax. Consumers will realize that these products are more expensive, and will adjust their purchases towards items made with reclaimed materials. These actions have a number of implications.

Manufacturers who previously used virgin materials extensively may need to adjust their production technology to use reclaimed materials. Under current MOE programs, they may be eligible for a subsidy or grant paid for by taxpayers.

Mining companies may feel that the virgin material taxes are discriminating against them arguing that with the imposition of this tax, cost cutting measures will have to be enforced. The net result may be job losses and a decline in GDP. However, the ensuing upsurge in the secondary materials sector may offset this.

A.7.4 Diversion potential

For a system of virgin material taxes to be successful, the rate has to be set so that waste generators have an incentive, to alter their production technology to utilize secondary materials. It is anticipated that this tax will be in the range of 5 to 12 percent of the cost of virgin material extraction depending on: the nature and development of secondary markets; whether the material is from a non-renewable or renewable resource, and the environmental and economic impacts of mining the virgin resource.

Assuming that the tax for each material is set in this range, it is anticipated that the following increases in recovery rates will be observed (Table A-11):

- Virgin material taxes will have a greater impact in Ontario on the IC&I sector with recovery rates of 15 per cent and 20 per cent for 1992 and 2000 respectively. For the same period, residential recovery will increase by 5 per cent and 4 per cent.

- Current trends predict that fine paper recovery in the IC&I sector will be well developed. With the imposition of a virgin material tax, it is anticipated that these recovery rates will increase by an additional 15 per cent and 20 per cent for the respective target years. Recovery from the residential sector will increase by 5 per cent for both target years.

- As boxboard markets come on stream, recovery from the IC&I sector will increase by 10 per cent and 15 per cent, while residential recovery will increase by 4 per cent for both 1992 and 2000.

Table A-11
Virgin materials taxes diversion parameters

Waste components - residential sector	1992	2000
ONP	Recycling +5%	Recycling +4%
Fine paper	Recycling +5%	Recycling +5%
Boxboard	Recycling +4%	Recycling +4%
Old corrugated cardboard	Reduction +5%	Reduction +7%
Glass containers	Recycling +4% Reuse +5%	Recycling +4% Reuse +5%
Aluminium cans	Recycling +6%	Recycling +9%
Tinplate steel cans	Recycling +6%	Recycling +7%
Other	Reduction +5%	Reduction +5%

Waste components - IC&I sector	1992	2000
ONP	Recycling +15%	Recycling +20%
Fine paper	Recycling +15%	Recycling +20%
Boxboard	Recycling +10%	Recycling +15%
Old corrugated cardboard	Recycling +10%	Recycling +10%
Glass containers	Recycling +3%	Recycling +4%
Aluminium cans	Recycling +12%	Recycling +17%
Tinplate steel cans	Recycling +4%	Recycling +7%
Other	Reduction +5%	Reduction +5%

- As markets for corrugated cardboard are already well developed, a relatively weak response is expected from the IC&I sector - a 10 per cent increase for both years. Residential recovery will increase by 5 per cent and 7 per cent for the same time frame.

- Given that glass can be cheaply made and silica is relatively abundant, taxes will increase recovery rates marginally. Response rate increases anticipated: residential recovery - re-use:5 per cent (both years), recycling: 4 per cent (both years); IC&I recovery - 3 per cent and 4 per cent.

- As current trends predict conservative recovery rates for aluminium cans and foils, it is anticipated that virgin material taxes will improve recovery rates. Recovery will increase by 12 per cent and 17 per cent in the IC&I sector, and by 6 per cent and 9 per cent in the residential sector.

- It is expected that tinplate steel cans recovery rates will improve by 4 per cent and 7 per cent in the IC&I sector, and by 6 per cent and 7 per cent in the residential sector.

- Virgin materials taxes, will increase source reduction of other wastes in the residential and IC&I sectors by 5 per cent in both 1992 and 2000.

A.8 Expanded *Blue Box* programs

The Ontario *Blue Box* program was started, on a pilot basis, in 1986. Over the last four years the program has expanded rapidly in southern and eastern Ontario. It is financed by the Ontario Multi-Material Recycling Inc. (OMMRI), the Ministry of the Environment, the Ministry of Northern Development and Mines (MNDM), and participating municipalities. These players fund the start up costs of the *Blue Box* program and the establishment of municipal recycling programs.

The *Blue Box* program is a multi-material collection program, which currently accepts only certain types of waste - newspapers (ONP), magazines, glass containers, plastics (PET and HDPE), aluminium cans and foil, and tinplate steel cans. It is primarily directed towards the residential sector.

The program is a voluntary source separation program. It is anticipated that the program will expand into new municipalities, apartment buildings and accepting new materials. The new materials will be those which have well developed secondary markets. This measure is specifically geared at the following waste components:

- fine paper;

- boxboard;

- old corrugated cardboard;

- telephone books;
- plastics (other RPC and film).

A.8.1 Empirical studies

A number of municipalities in other jurisdictions have operated programs similar to Ontario's *Blue Box* program.

Denmark

In the mid 1970's, the municipality of Høje Tastrup established a multi-material collection system which accepted paper, metals, bottles and glass. The collection system covered both single family units and apartments. The municipality was responsible for the operation of the recycling centre, while a private contractor collected the materials. Collection occurred once a month for single family units, while the schedule for apartments was flexible. Similar to the Ontario system, curbside pick-up was used by single-family units, while apartments used dumpster style containers.

Evaluation of the program indicated that the participation rates are good from the single family units, but response from apartments was not as good. The program yielded a recovery rate of 28.55 kg per capita per year. (OECD 1983;112-121).

United States

For multi-material collection programs in Marblehead and Somerville, Massachusetts, participation rates were estimated to be in the range of 75-80 per cent and 17-23 per cent, respectively. In Marblehead, 70 per cent of single family units and apartments were serviced, while in Somerville, programs were geared towards duplex and quadruplex houses in densely populated areas. In both of these communities, collection was curbside and once per week.

Recovery from these programs was 87.6 kg per capita per year in Marblehead, while it was in the range of 16.8 to 31.2 kg per capita per year in Somerville (OECD 1983;112-121).

Ontario

Ontario's residential waste recycling programs have increased dramatically in the last few years. In 1987, 400,000 households were served by the *Blue Box* program, by 1989, this number increased to 1.8 million. In 1990, it estimated that 2.1 million households were

serviced by the program. Of this, there is an 80 per cent coverage for urban areas, and 70 per cent for rural areas.

An estimated 115 kg of waste materials were recovered per household in 1989 (CH2M Hill 1991;5-7).

A.8.2 Efficiency

If the yard and food waste in the residential waste stream is ignored, the quantity of waste that has been recovered through the *Blue Box* program in Ontario has been impressive, given the fact that participation in the program is voluntary, that public education is minimal, and the fact that the program is primarily based on curbside pick-up.

Convenience and consistency are both crucial to maintain high citizen participation; therefore, weekly curbside recyclable pick-up on the same day as trash pick-up is likely to result in higher materials recovery that monthly pick-up on a separate day or a drop-off program. The number of separations required of the resident can also affect recovery rates. Fewer separations require less space at the residence for storage and can reduce collection time for pick-up crews, a crucial factor in the recycling cost equation (OTA 1989;64).

The success of curbside collection and recycling programs is also sensitive to the support programs implemented in conjunction with the recycling efforts. For example, an enhanced education program in Marblehead, Massachusetts resulted in higher participation rates in their curbside waste recycling program.

An alternative view of curbside recycling is that it results in high participation rates but poor recovery rates. Independent analysis in Ontario found that less than 23 per cent of the aluminium cans sold in the province were recycled and that only 28 per cent of plastic soft drink bottles were collected (Pollution Probe 1990;20-23).

Some municipalities involved in the program have realized the shortcomings of promoting only recycling. The amount of waste handled remains the same but waste diversion from landfill is through an expensive and complex recycling program and the markets for the waste material extracted are unstable and uncertain (Pollution Probe 1990;25).

A.8.3 Equity

Expanding *Blue Box* programs, like current residential waste collection and disposal, will be paid for indirectly by waste generators through property and provincial taxes whether or not they are included in the program. The programs impose a burden on participants, who have to clear and sort their recyclable materials, but since participation is voluntary this cannot be regarded as unfair. However, everyone benefits from increased recycling whether or not they take part.

A.8.4 Diversion potential

The Province allocated $38.5 million towards the *Blue Box* program in 1990. In May, 1990, it was announced that the *Blue Box* program will be expanded to include materials such as non-beverage aluminium, plastic film and boxboard. It is expected that the program will expand rapidly into the area of apartment recycling and into the small business sector. However, collection will still be under the umbrella of residential collection.

Given these assumptions and the effectiveness of this program, the following increases in collection, from the residential sector are assumed (Table A-12):

- ONP recovery will increase by 8 per cent and 14 per cent for 1992 and 2000 respectively.
- Recovery of fine paper will improve by 15 per cent and 25 per cent.
- As secondary markets for boxboard come on stream, increases in recovery of 10 per cent and 18 per cent will be realized.
- Increases of 9 per cent and 28 per cent in the recovery of corrugated cardboard will be realized.
- Telephone books recovery will increase by 10 per cent and 16 per cent for the respective target years.
- Gains of 7 per cent and 12 per cent in the recovery of magazines will be registered.
- Glass containers will be recovered at rates of 12 per cent and 13 per cent beyond current projections.
- Increases of 4.4 per cent and 14.7 per cent in the recovery of plastics will be realized.

Table A-12
Expanded *Blue Box* program diversion parameters

Waste components - residential sector	1992	2000
ONP	Recycling +8%	Recycling +14%
Fine paper	Recycling +15%	Recycling +25%
Boxboard	Recycling +10%	Recycling +18%
Old corrugated cardboard	Recycling +9%	Recycling +28%
Telephone books	Recycling +10%	Recycling +16%
Magazines	Recycling +7%	Recycling +12%
Glass containers	Recycling +12%	Recycling +13%
Plastics	Recycling +4.4%	Recycling +14.7%
Aluminium cans	Recycling +12%	Recycling +19%
Tinplate steel cans	Recycling +17%	Recycling +19%

- Given that aluminium cans have the greatest value in this program, recovery will increase by 12 per cent and 19 per cent for the respective target years.
- Tinplate steel cans recovery will increase by 17 per cent and 19 per cent.

A.8.5 Implementation costs

Table A-13 presents the estimated implementation costs of an expanded *Blue Box* program in the Province. In 1992, the expanded program is expected to cost an additional $8.6 million. In the year 2000, the increased cost of the program is expected to be about $13.8 million.

Table A-13
Cost of funding expanded *Blue Box* programs

Annualized cost of measure, 000's (1989$)		
CAPITAL COSTS	**1992**	**2000**
Approvals/Hearings	na	na
Site Acquisition	na	na
Equipment	na	na
Total Capital Costs	na	na
OPERATING COSTS		
Labour	na	na
Maintenance	na	na
Energy	na	na
Administration	na	na
Total Operating Costs	na	na
TOTAL COST	$8,591	$13,837

Sources:

CH2M Hill. 1991.

Note:

Increased *Blue Box* funding is based on committed expenditures for MSRP programs in 1990 (1989$) of $23.9 million, or $98.93/t, for curbside, apartment and depot diversion programs. Funding per tonne was calculated based on WMPM waste diversion estimate of 242,037 tonnes in 1989. Additional funding can be used for operating or capital expenses.

na - not available

A.9 Recycled content regulation

In regulating the recycled content of certain products, the government (Provincial and/or Federal) is legislating that a specific portion of that product must comprise secondary material. This regulation is imposed with the intent of recovering those components of the waste stream that can easily be recycled.

It is expected that recycled content regulation will be imposed on products which can utilize the following waste materials:

- ONP;
- fine paper;
- old corrugated cardboard;
- glass containers;
- aluminium cans; and
- tinplate steel cans.

A.9.1 Empirical studies

From the literature surveyed, no legislation, besides in the State of Florida[11], exists regarding recycled content. A number of jurisdictions in both Canada and the United States have proposed or are in the process of implementing recycled content legislation. Most of the proposed legislation focuses on recycled fibre content in newsprint.

There are provisions in existing laws in Ontario for recycled content regulations;

- The *Environmental Protection Act* makes provisions for a 50 per cent recycling rate of materials used in non-refillable containers; and
- there is pending legislation for 50 per cent recycled fibre content for newspapers.

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11 Florida State has an existing bylaw which requests compliance with its required content regulation for newsprint. (RIS/VHB, 1990:10)

The approach used by Ontario with regards to the present pop container regulation, may be applied to other materials. The Waste Reduction Advisory Committee (WRAC) has advocated the development of specific recycling rates for materials and products sold in Ontario and/or the use by manufacturers of equivalent amounts of secondary materials (Shrybman 1988;71).

A.9.2 Efficiency

A recycled content regulation can improve the use of secondary materials and it can be implemented with minimal cost to government (Shrybman 1990;71). Such a regulation should improve the capacity of producers to absorb secondary materials. The onus is on producers to comply with this regulation or else face charges.

Local markets may not be strong enough to supply enough recycled materials to ensure compliance with a recycled content regulation and imports, if available, may be required. This hardly helps solve Ontario's waste disposal problem.

The main argument against the imposition of a recycled content regulation is that recycling should not assume a pre-eminent position in the waste management hierarchy. Recycled content regulations are appropriate only when source reduction and re-use strategies have been explored and, where desirable, implemented (Shrybman 1988;71). Otherwise, the content regulation predisposes recycling above reduction and re-use.

It is expected the primary sector will be affected by this regulation. These effects are addressed in the macroeconomic analysis.

A.9.3 Equity

A recycled content regulation favours those able to manufacture products from recycled materials over those whose plant and equipment is not suitable. Also, supplies of virgin materials will also be disadvantaged by such a regulation and those in the recycling industry will benefit.

A.9.4 Diversion potential

A recycled content regulation will result in greater use of secondary materials. This will be further enhanced as consumer's preferences shift towards goods which contain recycled materials. Any increases in materials recovery realized through the residential sector will be through more materials collected through the *Blue Box* program. Increases in the industrial sector will be through enhanced industrial collection programs.

The following adjustments are a reasonable expectation for a recycled content regulation (Table A-14):

Table A-14
Recycled content regulation diversion parameters

Waste components - residential sector	1992	2000
ONP	Recycling +4%	Recycling +12%
Fine paper	Recycling +10%	Recycling +20%
Old corrugated cardboard	Recycling +9%	Recycling +13%
Glass containers	Recycling +4%	Recycling +8%
Aluminium cans	Recycling +20%	Recycling +20%
Tinplate steel cans	Recycling +12%	Recycling +14%

Waste components - IC&I sector	1992	2000
ONP	Recycling +10%	Recycling +20%
Fine paper	Recycling +10%	Recycling +20%
Old corrugated cardboard	Recycling +15%	Recycling +20%
Glass containers	Recycling +3%	Recycling +8%
Aluminium cans	Recycling +12%	Recycling +17%
Tinplate steel cans	Recycling +5%	Recycling +8%

- The projected recycling rates for ONP will be improved by 4 per cent and 12 per cent in the residential sector, and by 10 per cent and 20 per cent in the IC&I sector, for 1991 and 2000 respectively.

- Improvement of 10 per cent and 20 per cent in fine paper recovery will occur for the two sectors for both of the target years.

- With its well developed market, it is anticipated that corrugated cardboard recovery will be increased by 9 per cent and 13 per cent in the residential sector, and by 15 per cent and 20 per cent in the IC&I sector.

- Recovery of glass containers will increase by 4 per cent and 8 per cent, and 3 per cent and 8 per cent, for the residential and IC&I sectors, respectively, for the target years.
- With current trends predicting conservative recovery rates, a recycled content regulation should enhance residential recovery by 20 per cent for both target years, and in the IC&I sector by 12 per cent and 17 per cent.
- Tin plate steel can recovery will improve by 12 per cent and 14 per cent in the residential sector, and by 5 per cent and 8 per cent in the IC&I sector.

A.10 Mandatory source separation

Mandatory source separation (MSS) is a regulatory measure which can compel waste generators to separate their recyclable materials from their waste for disposal, so that it can be collected separately.

Mandatory source separation programs are typically applied to residential waste, but they can also be applied to IC&I waste.

Source separation is an effective waste management tool for segregating recyclable and compostable materials from the waste stream. Extensive experience with material recovery facilities that process unseparated wastes have failed to match the performance of source separation regimes. (Shrybman, 1988:40).

A.10.1 Empirical studies

There are many cases where MSS programs have been implemented. The literature reviewed focuses on MSS programs in North America.

United States

The first MSS statute in the U.S. was enacted in Rhode Island in 1986. Municipalities were required to separate designated recyclable materials; aluminium, glass and metal food and beverage containers, white goods, and plastic milk jugs and PET soda bottles, from solid waste to be disposed of at state run facilities. The Rhode Island Statute also requires IC&I source separation of various recyclable materials, including corrugated cardboard (Shyrbman 1988;Appendix A).

The MSS program is an integral part of the State's waste management goal of recycling 15 per cent of its MSW by 1992 (OTA 1989:319). No evaluation of the effectiveness of the MSS program could be found in the literature.

In 1987, New Jersey pursued the *Mandatory Source Separation and Recycling Act* requiring its 21 counties to develop a source separation strategy that identified yard waste (leaves) and at least three other materials as "designated recyclables". Under the program, households are required to separate these four materials. The effectiveness of this program has not been assessed (Shrybman 1988;Appendix A).

Hamburg, New York, has a well publicized mandatory recycling program. Participation in this program has been estimated at 98 per cent (Shrybman 1980;Appendix A).

Ontario

At present only a few small municipalities, such as South-West Oxford Township, Zorra and Midland, have implemented mandatory waste separation programs pursuant to the waste disposal provision of the *Municipal Act* (Shyrbman 1990;Appendix A).

These municipalities' bylaws require source separation of designated recyclable materials and empower the municipalities to refuse to collect garbage the has not been properly separated. The Zorra township bylaw carries a $2,000 fine for non-compliance, while the Midland bylaws prescribes a fine of $100 for non-compliance. In addition, the Midland bylaw enables the municipality to install recycling bins in apartment buildings and charge the cost to the landlord if he or she refuses to install this equipment in accordance with the bylaw (Shyrbman 1990;Appendix A). The participation rates in these programs is reported to exceed 90 per cent.

A.10.2 Efficiency

Mandatory source separation is one of the most effective waste management methods of extracting recyclable materials from the waste stream. MSS programs can significantly improve the extent of recycling.

For example, participation rates with respect to the voluntary Ontario *Blue Box* programs are approximately 65 per cent to 70 per cent, while experience with MSS programs in Ontario and Europe indicates that participation can be increased to 90 per cent to 95 per cent (Shyrbman 1990;40). Given that programs and infrastructures currently exist (*Blue Box*es and Industrial Waste exchange), MSS is feasible and a practical extension to these programs.

A.10.3 Equity

Assuming current programs will be enhanced at some cost, to accommodate increases in the recovery of waste, the costs associated with MSS will be paid for through taxation. It is not clear whether those who pay higher taxes receive a higher level of benefit from such a program.

A.10.4 Diversion potential

Through a MSS regulation, it is anticipated that these programs will be greatly enhanced. It is anticipated that with the imposition of MSS programs composting will also increase.

Given the success of pilot programs in small municipalities in Ontario, it is anticipated that the following changes, above and beyond current trends, will be observed (Table A-15 and Table A-16):

Table A-16
Mandatory source separation IC&I sector diversion parameters

Waste components - IC&I sector	1992	2000
ONP	Recycling +5%	Recycling +10%
Fine paper	Recycling +10%	Recycling +15%
Boxboard	Recycling +5%	Recycling +8%
Old corrugated cardboard	Recycling +15%	Recycling +25%
Glass containers	Recycling +4%	Recycling +8%
Plastics	Recycling +5.8%	Recycling +8%
Aluminium cans	Recycling +7%	Recycling +12%
Tinplate steel cans	Recycling +10%	Recycling +13%
Food waste	Reduction +5%	Reduction +8%
Wood waste	Recycling +10%	Recycling +15%

Table A-15
Mandatory source separation residential sector diversion parameters

Waste components - residential sector	1992	2000
ONP	Recycling +12%	Recycling +18%
Fine paper	Recycling +8%	Recycling +15%
Boxboard	Recycling +5%	Recycling +14%
Magazines	Recycling +7%	Recycling +12%
Old corrugated cardboard	Recycling +15%	Recycling +30%
Glass containers	Recycling +12%	Recycling +17%
Plastics	Recycling +7%	Recycling +17%
Aluminium cans	Recycling +20%	Recycling +20%
Tinplate steel cans	Recycling +15%	Recycling +15%
Food waste	Reduction +14%	Reduction +16%
Yard waste	Reduction +11%	Reduction +20%
Diapers	Reduction +7%	Reduction +12%

- ONP recovery in the residential sector will increase by 12 per cent and 18 per cent, while the recovery rate in the IC&I sector will be 5 per cent and 10 per cent, over the same time frame.

- With the imposition of MSS programs, fine paper recovery from households will register at 8 per cent and 15 per cent, while it will improve by 10 per cent and by 15 per cent from IC&I waste generators, over the same time frame.

- As markets for boxboard improve, recovery rates will be increased by 5 per cent and 14 per cent, and 5 per cent and 8 per cent for the residential and IC&I sectors, respectively.

- Magazines will be recovered from the residential sector at rates increasing by 7 per cent and 12 per cent for the target years.

- The recovery of corrugated cardboard will increase by 15 per cent and 30 per cent for the residential sector, and 15 per cent and 25 per cent for the IC&I sector.

- Recovery rates for glass containers will be enhanced by 12 per cent and 17 per cent in the residential sector, and by 4 per cent and 8 per cent in the IC&I sector, for 1992 and 2000, respectively.

- MSS programs will recover the highest quantity of plastics from the residential sector. Rates of recovery for 1992 and 2000 will increase by 7 per cent and 17 per cent respectively. For the same period, IC&I recovery will increase by 5.8 per cent and 8 per cent.

- Current future projections are low for the recovery of aluminium cans and foil. It is anticipated that recovery will be greatly enhanced through MSS programs. As a result, residential recovery will increase by 20 per cent for both target years, and 7 per cent and 12 per cent for the IC&I sector.

- Increases in the recovery of tinplate steel cans are also expected. The imposition of a MSS regulation will improve residential recovery by 15 per cent for both years in the residential sector, while increases of 10 per cent and 13 per cent in the IC&I sector are expected.

- With MSS programs, waste generators become more aware of the waste they dispose. With respect to food waste, it is anticipated households will compost more and industries put out more for "swill" and compost. Recovery, through reduction, in the residential sector will increase by 14 per cent and 16 per cent, and 5 per cent and 8 per cent for the IC&I sector, for 1992 and 2000 respectively. It is anticipated that residential yard waste, put out for disposal, will be further reduced by 11 per cent and 20 per cent, for the same period.

- Wood waste recovery from the IC&I sector will improve by 10 per cent and 15 per cent for the target years under a MSS regulation.

- As households become more aware of their waste management activities, it is anticipated that MSS programs will result in a shift from disposable to cloth diapers. The net result will be reductions of 7 per cent and 12 per cent for 1992 and 2000, respectively.

A.11 Landfill bans

Landfill is currently the waste disposal method of choice in Ontario. Over 90 per cent of waste generated in Ontario is landfilled (CH2M Hill 1991). However, Ontario is facing landfill constraints[12]. To preserve landfill capacity, a policy option available is to ban certain materials from disposal.

A landfill ban is a regulatory measure based upon the recyclability of waste. Landfill bans can be applied to both municipal (collected from households) and IC&I waste.

Landfill bans, in essence, signal the same intent as MSS programs: there exists a pool of recyclable waste components, which, through regulation have a better chance of being recycled. Such a regulation would provide municipalities and the IC&I sector with the incentive to recover a greater proportion of these recyclable materials.

It is anticipated that, like MSS programs, a system of fines will be invoked for non-compliance by landfill users.

A.11.1 Empirical studies

From the literature surveyed, there is little documentation of landfill bans. However, there are a number of precedents in Ontario.

In 1989, Metropolitan Toronto banned loads containing 50 per cent or more corrugated cardboard for landfill. The content was subsequently revised to 20 per cent and then zero per cent content per load. In 1989, the disposal of tires in landfill sites, was also banned. The *Waste Reduction and Recycling Program*, affected in 1991, has effectively banned from landfill recyclable wood products and scrap metal; contaminated fill; concrete; tires; and loads containing more than zero per cent recyclable cardboard. (Metro Commissioner of Works 1990). There is no evaluation of the effectiveness of these programs.

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[12] Approximately 54% of Ontario's landfill capacity will be lost in 1991 with the projected closure of the provinces three largest landfills: Britannia Road; Brock West; and Keele Valley (CH2M Hill 1991). Recently announced changes in landfill operations will extend these lives somewhat.

A.11.2 Efficiency

Landfill bans provide a strong incentive for reuse and recycling. The effects of bans apply equally to municipalities (who are responsible for residential waste) and the IC&I sector.

Landfill bans are efficient in eliciting an initial reduction in the amount of waste sent for disposal. Like user charges and MSS programs, the success of landfill bans depends upon the success of other waste management programs. These alternative programs should absorb materials diverted from disposal as a result of the bans.

Landfills are either publicly or privately owned. Landfill bans will probably affect both types of landfills. Monitoring of loads for disposal would be done thoroughly at public landfills. At private landfills, where disposal generates revenue, monitoring may not be stringently enforced. Some illegal dumping can be expected to result from a landfill ban even with a concerted effort to ensure compliance.

A.11.3 Equity

A landfill ban has a different effect on households and the IC&I sector depending on their use of the banned materials. However, this is unlikely to impose any serious inequities.

A.11.4 Diversion potential

Given the current landfill constraints in Ontario and the increased cost of disposal, it is anticipated that bans will be effective. If extensive landfill bans are implemented, it has been assumed that the markets for secondary materials will be able to absorb all materials that were made available. It is also assumed that regulations will be imposed on both public and private landfills.

Given the ease and low cost of implementing landfill bans, it is anticipated that the following changes will be observed (Table A-17):

- A landfill ban on ONP will prove to be an effective mechanism to greater recovery. Recovery will increase by 23 per cent and 24 per cent in the residential sector. With upgraded diversion initiatives, the IC&I sector will begin to recover ONP at rates of 15 per cent and 25 per cent in 1992 and 2000, respectively.

- Residential recovery of corrugated cardboard will increase by 30 per cent and 50 per cent for the respective target years. IC&I recovery of this material, already well developed, will increase by 30 per cent and 25 per cent for the same period.

Table A-17
Landfill bans diversion parameters

Waste components - residential sector	1992	2000
ONP	Recycling +23%	Recycling +24%
Old corrugated cardboard	Recycling +30%	Recycling +50%
Diapers	Reduction +13%	Reduction +22%
Yard waste	Reduction +35%	Reduction +40%
Wood waste	Recycling +20%	Recycling +30%
Tires	Recycling +10%	Recycling +15%
Other	Reduction + 5%	Reduction + 5%

Waste components - IC&I sector	1992	2000
ONP	Recycling +15%	Recycling +25%
Old corrugated cardboard	Recycling +30%	Recycling +25%
Diapers	Reduction +15%	Reduction +18%
Yard waste	Reduction +10%	Reduction +15%
Wood waste	Recycling +20%	Recycling +20%
Drywall	Recycling +15%	Recycling +20%
Foundry sands	Recycling +4%	Recycling +5%
Tires	Recycling +10%	Recycling +12%
Other	Reduction + 10%	Reduction + 10%

- Yard waste will be banned from landfills. Municipalities will pick up the slack through current and projected composting programs. Reduction via the residential sector will increase by 35 per cent and 40 per cent, while IC&I recovery will increase by 10 per cent and 15 per cent.

- Wood waste, being easily recyclable, will be banned from landfill. Recovery rates in the IC&I sector will increase by 20 per cent for both target years, while residential recovery will increase by 20 per cent and 30 per cent.

- Tires, more effectively banned from landfills, will be recycled to a greater extent given current technology. Residential and IC&I recovery will increase by 10 per cent and 12 per cent, for 1992 and 2000 respectively.

- Drywall, from construction/demolition waste recycling will increase by 15 per cent and 20 per cent for the IC&I sector.

- Markets for foundry sands are still in the infancy stage. Bans will be levied on a per cent of load basis. The resulting increases in IC&I recovery rates will be 4 per cent and 5 per cent for 1992 and 2000, respectively.

- With landfill bans, consumers and institutions will switch from disposable to cloth diapers. Compliance with landfill bans will result in reduction increasing by an additional 13 per cent and 22 per cent from the residential sector, and 15 per cent and 18 per cent from the institutional sector.

- The amount of *Other* residential waste will be reduced by 5 per cent in both years and the amount of *Other* IC&I waste will be reduced by 10 per cent in both years.

A.12 Packaging taxes

Packaging represents the largest single component of MSW and is expected to comprise as much as 50 per cent by volume of MSW by the year 2000 (Shrybman 1988;34). Studies of the physical dimensions of solid waste management show that packaging represents as much as 30 per cent of municipal solid waste by weight.

Packaging taxes are essentially charges on a per unit basis to firms whose products are packaged. The taxes may be calculated according to the proportion of packaging by weight or volume of the product or related to other parameters such as the difficulty of disposing of the packaging and packaging toxicity. These charges, although levied against producers, are, to some extent, transferred to consumers.

Packaging taxes provide an incentive to producers to reduce the volume and/or weight of packaging in their products. The tax also provides an incentive to consumers to purchase less *packaging-intensive* goods.

When implementing packaging taxes, determining the level of the tax is crucial. Packaging taxes, like user charges, should take into account the following costs: the fixed and operating costs of waste collection; the fixed and operating costs of landfills, including the costs of site closure and post-closure site monitoring; and any external social and environmental costs of solid waste management. The tax should be implemented in a fashion which provides adequate time for producers to adjust their behaviour.

It is expected that packaging taxes will affect the following components of the waste stream:

- boxboard;
- old corrugated cardboard;
- plastics; and
- composite packaging.

A.12.1 Empirical studies

In 1988, 300 solid waste bills were introduced in State legislatures of the United States specifically addressing packaging issues (Tellus 1990;1-1).

New York State has introduced a number of packaging initiatives. The *Waste Reduction and Recycling Act*, 1988, places a $0.03 (US$) fee on non-recyclable rigid and semi-rigid plastic containers used for non-food retail packaging and fast-food packaging. Exempt from the tax are all grocery foods, recyclable packages and returnable bottles (OTA 1989;314:Tellus 1990;1-10).

Massachusetts, Minnesota, Maine and Iowa have proposed taxes similar to New York's, ranging from $0.01 to $0.05 (US$) per package, applied to either manufacturers or distributors (OTA 1989;314).

Oregon's *Plastic Container Tax Act* applies to suppliers making the first sale of plastic containers in the State. The tax is based on a percentage of gross sales (Tellus 1990;1-10).

In 1989, Vermont passed a Bill similar to the Oregon Bill. The Bill dictates a tax on gross receipts at a rate of 0.05 percent for all pre-packaged materials sold in Vermont. A tax of $0.02 (US$) is charged on empty packaging used on-site (e.g., fast-food restaurants). Vermont has an exemption system for packaging which is made from recycled material (Tellus 1990;1-10).

California is considering a tax of $0.09 (US$) per kg on all non-recyclable and non-degradable plastic products. This tax is to be paid by manufacturers or distributors.

As these programs are still young, no feedback on their effectiveness is found in the literature.

A.12.2 Efficiency

Packaging taxes, in theory, increase the efficiency of municipal solid waste management by encouraging producers to reduce the amount of packaging and consumers to opt for less *package-intensive* items. In aggregate the potential effects of a packaging tax are to (Tellus 1990:1-11):

- reduce packages manufactured;
- reduce packages bought;
- raise revenues;
- stimulate demand for recyclable materials; and
- promote the production of products made with recycled materials.

However, the packaging tax concept has not been fully analyzed, particularly the relationship between the disposal costs of a package, the suggested tax rates, and MSW generation rates. Moreover, in portions the tax rate may be too low to induce change across the multitude of packaged products that industries sell. If manufacturers rather than retailers or consumers are charged the tax, they can maintain their profit margins by passing the tax along in the price of products or they can decide that paying the tax is preferable to changing product design. Moreover, unless some special labelling is required on the packages that are subject to a tax, most consumers will never know they are paying the tax. (OTA 1990;314,315).

A.12.3 Equity

Given the materials upon which packaging taxes are levied, waste generators may adjust their behaviour to minimize their tax load. Packaging taxes should help eliminate the possibilities of the thrifty subsidizing the wasteful.

If packaging taxes fail to induce behavioural changes, they may only be a revenue generating mechanism paid accordingly to one's use of packaging. This is likely to be at least proportional to income and may even be progressive. Much depends on how packaging varies with the value of the products contained.

A.12.4 Diversion potential

Given the current landfill constraints in Ontario, and the increased cost of disposal for packaging taxes to be successful, the charge has to be high enough to induce a change in behaviour. A charge greater than $0.05 per package, depending on the recyclability of the package, is assumed to induce significant behavioural changes. Producers will reduce the packaging component of the products and consumers will purchase less *package-intensive* goods.

It is anticipated that the following changes will be observed (Table A-18):

Table A-18
Packaging taxes diversion parameters

Waste components - residential sector	1992	2000
Boxboard	Reduction +5%	Reduction +8%
Old corrugated cardboard	Reduction +5%	Reduction +7%
Plastics	Reduction +7.6%	Reduction +12.6%
Composite Packaging	Reduction +8% Recycling +5%	Reduction +15% Recycling +7%

Waste components - IC&I sector	1992	2000
Boxboard	Reduction +3%	Reduction +5%
Old corrugated cardboard	Reduction +3% Recycling +15%	Reduction +5% Recycling +17%
Plastics	Reduction +5.1%	Reduction +5.6%
Composite Packaging	Reduction +8% Recycling +5%	Reduction +15% Recycling +7%

- The generation of boxboard will be reduced by 5 per cent and 8 per cent in the residential sector, and 3 per cent and 5 per cent by the IC&I sector, for 1992 and 2000 respectively.

- In the residential sector, consumers will begin to move away from particular items packed in corrugated cardboard. Alternatively, for other items, they will leave the disposal of this waste item to the IC&I sector. As a result, reduction of 5 per cent and 7 per cent will be achieved in residential corrugated cardboard generation. Reductions by 3 per cent and 5 per cent with increases in recycling of 15 per cent and 17 per cent will be observed in the IC&I sector for the respective target years.

- The only components of the plastics waste stream that will be affected are other rigid plastic containers (RPC) and film. The net effect will be reductions in plastic waste generation of 7.6 per cent and 12.6 per cent by the residential sector, and 5.1 per cent and 5.6 per cent by the IC&I sector.

- The markets for secondary composite packaging are currently being developed (eg. "Superwood"). However, their desirability as a packaging item is questionable. The net result of these trends and packaging taxes is assumed to be as follows: in the residential sector reductions of 8 per cent and 15 per cent, and increases in recycling of 5 per cent and 7 per cent will be realized; reduction rates in the IC&I sector will be the same as the residential sector. An estimate of recycling is difficult to assess for the IC&I sector given current trends and it is assumed to be the same as for the residential sector.

A.13 Industrial waste audits

Industrial waste audits are a regulatory means of inducing the IC&I sector to scrutinize their waste generation activities. The audit consists of an assessment of a firm's production process, the type and quantity of wastes generated, and current waste management activities. Audits are conducted with the objective to improving the cost effectiveness and efficiency of a firms's waste management practices and often result in the implementation of reduction and recycling measures (Shrybman 1988;44,45).

It is expected that waste audits will affect most of the waste components in the IC&I sector.

A.13.1 Empirical studies

Rhode Island

In 1988, Rhode Island passed a regulation mandating source education and recycling planning by generators of commercial solid waste. The *Rhode Island Recycling Act* requires all generators of commercial solid waste, employing more than 500 people to submit a source reduction and recycling plan to the Department of Environment management. The measure

complements regulations that mandate source reduction of corrugated cardboard, office paper, glass food and beverage containers, tinplate steel cans, aluminium and newspaper from the commercial waste stream (Shrybman 1988;45). The program boasts a 20 per cent reduction in the waste generated by the IC&I sector.

Ontario

William Neilson Ltd. (WNL) of Toronto in early 1988 implemented a comprehensive waste reduction policy. Prior to the recycling program, employees conducted a ten day waste audit. For their waste audit, WNL broke their waste into five categories: general (miscellaneous), corrugated cardboard, packaging, food and cafeteria waste. Waste was diverted through existing waste reduction and recycling programs.

From the programs that were pursued after the waste audit, impressive results were achieved. WNL's waste output in 1988 was 1740 tonnes, which was reduced by 34 per cent to 1145 tonnes in 1989 (SWEAP Summer 1990;7,8).

A.13.2 Efficiency

From initial assessments, waste audits are an effective means of reducing and recycling waste generated, by the IC&I sector. Given that the composition of waste varies by industry, waste audits could provide a basis for developing sector specific waste reduction standards (Shrybman 1988;46).

Waste audits also promote a better allocation of resources. From the waste reduced, there are savings in disposal costs and landfill life. Waste audits also increase revenue through the sale of reclaimed materials and reduce a firm's waste storage needs.

A.13.3 Equity

Waste audits can improve solid waste management for any industry or firm. Waste audits promote a better allocation of resources. The cost of waste audits should be justified by the savings they promote so no cross subsidization will be required.

A.13.4 Diversion potential

It is anticipated that industrial waste audits will have a significant impact on waste diversion and generation in the IC&I sector. Companies and institution will realize the benefits of such programs. It is anticipated that waste will be diverted through existing and projected waste diversion programs.

A regulation imposing waste audits, starting with the largest firms and institutions is assumed. The regulation will have an assumed 100 per cent compliance rate. However, there are a large number of small firms which will be unaffected by this regulation.

It is anticipated that the requiring of waste audits in the IC&I sector will result in the following waste diversion (Table A-18):

- With the advent of waste audits, IC&I generators will begin to recover ONP at rates of 15 per cent and 25 per cent.

- With the demand for fine paper, waste audits will open more avenues towards greater recycling, increasing recovery by 15 per cent and 25 per cent.

- Boxboard markets are currently being developed. With waste audits it is expected that recovery of this item will increase by 10 per cent and 20 per cent.

- Corrugated cardboard, which is in high demand and easily recyclable, will be recovered at rates of 20 per cent and 30 per cent greater than projected estimates.

- Recovery of magazines will increase by 5 per cent and 10 per cent for the two target years.

- As technology is updated, the need by industry, to have telephone books will decline. With the increasing use of electronic media, there will be reductions of 8 per cent and 15 per cent in telephone books in the IC&I waste stream.

- Glass containers will be recovered at rates 5 per cent, for both years, above projected rates.

- Waste audits will cause industries to re-evaluate the use and production of plastics. Changes in technology will result in reductions of 5 per cent and 8 per cent, while recycling will increase by 2.2 per cent and 7.2 per cent, for the target years.

- Given developed markets for aluminium, increases in recovery of 7 per cent and 12 per cent are expected.

Table A-19
Industrial waste audits diversion parameters

Waste components - IC&I sector	1992	2000
ONP	Recycling +15%	Recycling +25%
Fine paper	Recycling +15%	Recycling +25%
Boxboard	Recycling +10%	Recycling +20%
Old corrugated cardboard	Recycling +20%	Recycling +30%
Magazines	Recycling +5%	Recycling +10%
Telephone books	Reduction +8%	Reduction +15%
Glass containers	Recycling +5%	Recycling +5%
Plastics	Reduction +5% Recycling +2.2%	Reduction +8% Recycling +7.2%
Aluminium cans	Recycling +7%	Recycling +12%
Tinplate steel cans	Recycling +5%	Recycling +8%
Tires	Recycling +5%	Recycling +5%
Food waste	Reduction +10%	Reduction +20%
Yard waste	Reduction +10%	Reduction +17%
Wood waste	Recycling +10%	Recycling +14%
Other	Reduction + 10%	Reduction + 10%

- The recovery of tinplate will increase by 5 per cent and 8 per cent, for 1992 and 2000 respectively.
- Recovery rates for tires are projected to be quite high. With mandatory waste audits, industry will increase recovery by 5 per cent for both target years.
- Food waste, through "swilling" and composting programs, will be reduced by a further 10 per cent and 20 per cent.
- Yard waste will be reduced by 10 per cent and 17 per cent.

- As further markets are developed for wood waste, recovery will increase by 10 per cent and 14 per cent for 1992 and 2000 respectively.
- A 10 per cent reduction of *Other* wastes in both years is expected.

A.14 Product bans

Product bans are regulations whereby the manufacturing and selling of certain items are banned due to the nature of their toxicity, recyclability and/or biodegradability. Product bans can also be applied to the production of products. Hence, they affect the nature of the waste disposed from both the residential and IC&I sectors.

For violating a product ban, a fine is imposed. It is anticipated that this will be a sufficient incentive to producers to comply with product bans by adjusting technology and in some cases, increasing the recyclability of their product.

The most crucial decisions in implementing a product ban relate to the timing of the ban and the level of fines for non-compliance. If a product is banned, it takes time before technology can be adopted to produce alternative products. The level of the fine and enforcement effort should be such that they ensure a high degree of compliance.

A.14.1 Empirical studies

Product bans usually target packaging and plastic products which are non-recyclable and single use products. As of 1989, in the United States, 16 States had legislation pending that would ban or prohibit the use of some plastic materials or polystyrene, or require the use of biodegradable materials (OTA 1989;315).

Suffolk County and Lockland County in New York have pending legislation banning polystyrene for food packaging. Suffolk County has also proposed bans on polyethylene grocery sacks and polystyrene or polyvinyl chloride in eating utensils (OTA 1989;315). The State of Maine and Berkeley, California, also have proposed similar legislation.

Legislation enacted in the United State includes a law in Minnesota (1987) banning plastic beverage containers; and a ban on Tetrapaks containers in Connecticut. As the legislation has only recently been introduced, there is no information on the effectiveness of these bans.

A.14.2 Efficiency

Bans generally focus on a small portion of MSW (OTA 1989;26). Even so, their implementation could provide a useful mechanism for reducing waste.

Two problems associated with product bans have been identified.

- replacements for these products may not be improvements; and
- the economic implications for retail outlets are uncertain (OTA 1990;316).

If single-use food packaging products are considered, the cost of replacements, the cost of labour and energy to clean reusable and the cost of cleaning equipment, have to be taken into account in an overall assessment of efficiency. The result may be the lowering of disposal costs, and reusable product manufacturers obtaining more business. However, producers may switch to heavier, bulkier, recyclable alternatives which may not be captured through existing recycling programs collection, or the alternatives may cost more to produce.

A significant shift from plastic to paper bags could occur (OTA 1989;316). But, switching from plastic to paper bags could actually increase waste generation because paper bags take up more landfill space than plastic bags, and paper does not degrade rapidly in landfills.

The possible efficiency gains arising from product bans are unclear.

A.14.3 Equity

There are a number of problems faced by retail outlets and manufacturers. As single-use products are banned, more labour and energy may be required for reusable products or packaging. As a result, consumers will have to pay higher prices for certain services. Jobs may be lost in plastics manufacturing. However, jobs may be created in service industries and other manufacturers may gain from more business.

A.14.4 Diversion potential

Product bans may have little impact on waste diversion. Waste that may be diverted through bans may show up (in quantity) as a different type of waste (e.g., paper for plastics). It is felt that the IC&I sector will make changes in the types of products offered to consumers regardless of policy. Their action will be based on consumer demand.

If product bans are implemented it is anticipated that the following adjustments in waste generation and diversion will be observed (Table A-20):

Table A-20
Product bans diversion parameters

Waste components - residential sector	1992	2000
Boxboard	Waste management +2%	Waste management +4%
Old corrugated cardboard	Waste management +2%	Waste management +3%
Mixed paper	Waste management +2%	Waste management +5%
Plastics	Reduction +2.6 %	Reduction +5.3%
Composite packaging	Reduction +10%	Reduction +25%
Diapers	Reduction +27%	Reduction +41%

Waste components - IC&I sector	1992	2000
Boxboard	Waste management +2%	Waste management +3%
Old corrugated cardboard	Waste management +2%	Waste management +4%
Mixed paper	Waste management +2%	Waste management +5%
Plastics	Reduction +2.6 %	Reduction +5.3%
Composite packaging	Reduction +10%	Reduction +25%
Diapers	Reduction +15%	Reduction +22%

- Waste generators will substitute mixed paper, boxboard and corrugated cardboard for other RPC and film. As a result, more of these materials will appear in the waste stream. For 1992 and 2000, respectively, the following reductions will be observed: mixed paper -- 2 per cent and 5 per cent; boxboard -- 2 per cent and 5 per cent; and corrugated cardboard -- 2 per cent and 3 per cent. The net reductions in plastics will be 2.6 per cent and 5.3 per cent. The 1992 estimates are applicable to both sectors. For the year 2000, the IC&I diversion parameters are 3 per cent for boxboard and 4 per cent for OCC.

- Composite packaging can be banned. However, secondary markets for this material are in their infancy. Given a ban, it is expected that this material will be reduced by 10 per cent and 25 per cent from both the residential and IC&I solid waste stream.

- The item most likely to be seriously affected by a product ban is disposable diapers. As generators switch from disposable diapers to cloth the following changes will occur: Residential sector, increases in reduction of 27 per cent and 41 per cent; and IC&I sector, increases in reduction of 15 per cent and 22 per cent for the respective target years.

A.15 Increased funding to municipalities for recycling and reduction programs

Increased funding to municipalities is a provincial initiative designed to support the budget estimates of municipalities. Municipal reduction/recycling program are traditionally geared towards the residential sector. With the success of the *Blue Box* program, increasing funding to diversify programs is a logical next step.

Increasing funding would entail supporting a number of the measures already discussed elsewhere in this report. Funding increases will open further avenues for waste generators to reduce and recycle their waste. A crucial decision for municipalities will be where to focus the increased funds. It is assumed that since the residential sector will have few problem in meeting the 25 per cent and 50 per cent diversion target, additional monies will be geared towards the IC&I sector.

A.15.1 Empirical studies

The quantity of materials collected from the *Blue Box* and other municipal recycling programs are well documented (CH2M Hill 1991) and is discussed elsewhere in the present report.

A.15.2 Efficiency

The efficiencies of possible programs that would likely be funded have been discussed in the sections on *Blue Box* programs and other measures.

A.15.3 Equity

Any increased funding to municipalities has to come from the provincial tax system. A large portion of any incremental spending by municipalities will be geared towards IC&I waste reduction and recycling. Given that municipalities offer a number of tax concessions for industries to locate in their area, residents may feel that any programs directed towards this sector may be unjustified. Municipalities may argue that increased funding would translate into increased diversion, which would lead to a more efficient allocation of resources in the community.

A.15.4 Diversion potential

It is anticipated that increased funding will finance the following types of programs: subsidized home composters, yard and organic waste collection, education, expanded *Blue Box* programs and industrial waste audits. These programs are assumed to be implemented to a broader extent than if they were implemented independently.

Given the potential of these programs, through increased funding, it is anticipated that the following changes will be observed (Table A-21 and Table A-22):

- The residential recovery of ONP will increase by 13 per cent and 19 per cent as a result of increased funding. In the IC&I sector, enhanced programs will realize recycling rates of 10 per cent and 20 per cent for 1992 and 2000 respectively.

- Increased funding will help expand current recovery systems and, hence, recovery of fine paper from the residential sector will increase by 12 per cent and 17 per cent for the two target years.

- As markets for boxboard come on stream, recovery from the residential sector is expected to increase by 10 per cent and 13 per cent.

- Corrugated cardboard will be recovered at an additional 20 per cent and 30 per cent over and above current trend projections for the residential sector. IC&I recovery of corrugated cardboard will increase by 20 per cent and 25 per cent over the designated period.

- Recovery of magazines from the residential sector will increase by 8 per cent and 12 per cent.

- Increased recovery of telephone books will be relatively small. In the residential sector gains of 5 per cent and 10 per cent will be realized, while in the IC&I sector

Table A-21
Increased funding to municipalities for recycling and reduction programs residential diversion parameters

Waste components - residential sector	1992	2000
ONP	Recycling +13%	Recycling +19%
Fine paper	Recycling +12%	Recycling +17%
Boxboard	Recycling +10%	Recycling +13%
Old corrugated cardboard	Recycling +20%	Recycling +30%
Magazines	Recycling +8%	Recycling +12%
Telephone books	Recycling +5%	Recycling +10%
Glass containers	Recycling +11%	Recycling +12%
Plastics	Recycling +3.3%	Recycling +9.5%
Aluminium cans	Recycling +12%	Recycling +19%
Tinplate steel cans	Recycling +7%	Recycling +14%
Food waste	Reduction +3.5%	Reduction +7%
Yard waste	Reduction +25%	Reduction +55%
Other	Reduction +5%	Reduction +5%

these increases will be 2.5 per cent and 5 per cent above base line projections.

- Recovery of glass containers by the residential sector will increase by 11 per cent and 12 per cent, while increases in the IC&I sector will be 5 per cent and 8 per cent, for 1992 and 2000 respectively.

- Increased funding will focus on plastics recovery for the residential sector. As a result, gains of 3.3 per cent and 9.5 per cent will be realized for the target years.

- Aluminium will be recovered at rates of 12 per cent and 19 per cent from the residential sector, and 7 per cent and 17 per cent from the IC&I sector, over and above current trend projections.

Table A-22
Increased funding to municipalities for recycling and reduction programs IC&I diversion parameters

Waste components - IC&I sector	1992	2000
ONP	Recycling +10%	Recycling +20%
Old corrugated cardboard	Recycling +20%	Recycling +25%
Telephone books	Recycling +2.5%	Recycling +5%
Glass containers	Recycling +5%	Recycling +8%
Aluminium cans	Recycling +7%	Recycling +17%
Tinplate steel cans	Recycling +5%	Recycling +10%
Food waste	Reduction +5%	Reduction +10%
Yard waste	Reduction +10%	Reduction +20%
Other	Reduction +5%	Reduction +5%

- For the residential sector, tinplate steel cans will be recovered at rates of 7 per cent and 14 per cent above the current trend projection. Recovery for the IC&I sector will increase by 5 per cent and 10 per cent.

- Through the distribution of subsidized home composters, food waste from the residential sector will be reduced by a further 3.5 per cent and 7 per cent. A further 5 per cent and 10 per cent of food waste will be diverted from the IC&I sector through "swilling".

- Yard waste collection would result in a 25 per cent and 55 per cent increase in waste diversion from the residential sector and a 10 per cent and 20 per cent diversion of waste from the IC&I sector, for 1992 and 2000, respectively.

A.15.5 Implementation costs

Table A-23 presents the implementation costs of increased funding to municipalities. Excluding any additional collection and processing costs funding is assumed to increase by about \$35.4 million in 1992 and by about \$44.7 million in 2000.

Table A-23
Cost of increased funding to municipalities for recycling and reduction programs

Annualized cost of measure, 000's (1989$)		
CAPITAL COSTS	**1992**	**2000**
Approvals/Hearings	na	na
Site Acquisition	na	na
Equipment	na	na
Total Capital Costs	na	na
OPERATING COSTS		
Labour	na	na
Maintenance	na	na
Energy	na	na
Administration	na	na
Total Operating Costs	$35,362	$44,742
TOTAL COST	$35,362	$44,742

Source:

CH2M Hill 1991.

Note:

Increased funding to municipalities is estimated from the MSRP program based on funding of \$37.5 million in 1990 (1989\$) for curbside and depot programs, industrial waste audits, community and home composting and research and development for end-use products and 429,580 tonnes of waste diverted in 1989 (WMPM). Additional funding is assumed for operating expenses only.

na - not available

A.16 Mandatory processing of solid waste collected

Mandatory processing of solid waste collected from the residential and IC&I sector is a regulatory measure that increases the recovery of certain materials. This regulation would have a significant impact on waste diversion.

Mandatory processing involves sorting solid waste collected from households and industry. This sorting would typically take place at some centralized materials recovery facility (MRF). At a MRF waste is sorted through various means - mechanical, magnetic, etc. The materials collected are sent for recycling, while the residual is either landfilled or incinerated.

A.16.1 Empirical studies

Ontario

In 1978, Metro Toronto began a pilot project, at the Downsview Resource Recovery facility. It was one of the earliest experiments in Canada for processing solid waste. The facility processed approximately 13,000 tonnes/a of mixed solid waste annually. Compost estimated at 5,000 to 6,000 tonnes/a was generated. This facility ceased operation in 1986, due to the fact that the quality of the compost was poor - high content of plastic and metal rendered the final product only suitable for landfill cover and landscaping (Proctor & Redfern Group 1989;4-5).

United States

In 1983, the Delaware Reclamation Plant began operations. It is designed to process solid waste and municipal sewage sludge from New Castle County, Delaware. The facility recovers ferrous metals, glass, and non-ferrous metals, and produces compost with mixed sewage sludge (OTA 1990;138). The facility accepts 560,000 tonnes/a of solid waste and sewage sludge and recovers and sells light ferrous metals, aluminium and a small amount of glass. The compost generated is used as landfill cover. No information is available in the quantities of materials recovered.

In 1989, *The ORFA Corporation of America* completed a mixed waste facility in Philadelphia, Pennsylvania. The facility is designed to process 90,000 tonnes/a of MSW. The facility produces: ORFA Fibre cellulose granulate, used to produce recycled paperboard, building board, kitty litter, growing medium and granulate which consists of plastics, glass, mixed sand, dust, grit, nonferrous metal and other dense substances used to fill strip mines and ferrous metals. It is estimated that 50 to 60 percent of the processed waste becomes ORFA

Fibre, 18 percent becomes granulate, and 8 percent is ferrous metal (which is sold to scrap dealers).

Both of these facilities shred the solid waste before processing.

A.16.2 Efficiency

Early studies of MRF's focused on electromagnetic separation to retrieve ferrous metals. Recovery rates of up to 80 per cent were claimed (Holmes 1981;19). However, experience has shown that shredding the waste in the pre-treatment phase can improve the efficiency of separation from about a 50 per cent to a 90 per cent recovery rate (Porteous 1977;52). Recent experience with the ORFA corporation has shown that recovery from mixed solid waste can be as high as 85 per cent.

Given the effectiveness of the recovery of secondary materials from solid waste, a policy that will require waste haulers to process waste before disposal is very attractive. However, these facilities are very expensive and costly to operate. For example, OFRA are planning to build a new plant, with an annual processing capacity of 132,000 tonnes and capital costs in the range of $30 to $35 million (US$) (OTA 1989;138). To cover some of these expenses, tipping fees are charged to raise revenues.

Given these constraints, a cost-effective development strategy for such facilities is needed. In Ontario, there are a number of transfer stations, which have the basic infrastructure and tipping fee tariff, that could provide the basis for mixed waste processing facilities.

A.16.3 Equity

Mixed waste processing facilities are expensive. Their impact on different segments of society will depend on how they are financed. Some combination of fee for service and use general revenues is expected.

A.16.4 Diversion potential

The example of the OFRA plant indicates the excellent diversion potential of these facilities. It is anticipated that mandatory processing of solid waste will affect the behaviour of both the residential and IC&I sectors.

Assuming this measure is implemented independently of other policies, it is expected that industry and households will slacken their recovery activities of certain materials. This results from the knowledge that MRFs will be recovering these materials.

If more MRFs are built in Ontario and are phased in within the next five years, it is anticipated that the following waste diversion will occur (Table A-24):

- Recovery of boxboard in the solid waste management (SWM) sector will occur at rates of 7 per cent and 40 per cent in 1992 and 2000 respectively.

- Given the potential uses of OFRA Fibre, it is expected that mixed paper will be recovered by the SWM sector at rates of 7 per cent and 40 per cent for the respective target years.

- Glass recovery from the residential and IC&I sectors will decline. Anticipated declines in recovery will be 2 and 5 per cent for the residential sector, and 3 per cent and 7 per cent for the IC&I sector. The SWM sector will pick up this slack, with improved recovery, of 5 per cent and 33 per cent, for the designated period.

- With the implementation of mixed waste MRF's recovery from the SWM sector will be 3 per cent and 22 per cent of plastics.

- Like glass containers, recovery of aluminium products will decline in the residential sector, at rates of 3 per cent and 7 per cent. This decline will be transferred to the SWM sector, where recovery rates of 5 per cent and 75 per cent will be realized, in 1992 and 2000 respectively.

- Declines of 3 per cent and 7 per cent will be observed for tinplate steel recovery, in the residential sector. Given that this material can be easily removed (through electromagnetic means) from mixed solid waste, recovery of 5 per cent and 75 per cent will be realized for the respective target years.

A.16.5 Implementation costs

Table A-25 presents the estimated costs of implementing mandatory processing of solid wastes collected. To achieve the diversions assumed above, it is estimated that a total of 9 MRF facilities will be required in 1992 at an annualized cost of about $3.9 million per annum. In 2000, an estimated 62 MRFs will be required costing about $26.7 million per annum. Implementation costs are for the construction and operation of the MRF facilities only.

Table A-24
Mandatory processing of solid waste collected diversion parameters

Waste components - residential sector	1992	2000
Glass containers	Recycling -2%	Recycling -5%
Aluminium cans	Recycling -3%	Recycling -7%
Tinplate steel cans	Recycling -3%	Recycling -7%

Waste components - IC&I sector	1992	2000
Glass containers	Recycling -3%	Recycling -7%

Waste components - solid waste management	1992	2000
Boxboard	Recycling +7%	Recycling +40%
Mixed paper	Recycling +7%	Recycling +40%
Glass containers	Recycling +5%	Recycling +33%
Plastics	Recycling +3%	Recycling +22%
Aluminium cans	Recycling +5%	Recycling +75%
Tinplate steel cans	Recycling +5%	Recycling +75%

Table A-25
Cost of a mandatory processing of solid waste collected

Annualized cost of measure, 000's (1989$)		
CAPITAL COSTS	**1992**	**2000**
Approvals/Hearings	$0	$0
Site Acquisition	$416	$2,861
Equipment	$242	$1,668
Total Capital Costs	$658	$4,529
OPERATING COSTS		
Labour	$1,962	$13,497
Maintenance	$450	$3,096
Energy	$450	$3,096
Administration	$360	$2,476
Total Operating Costs	$3,222	$22,165
TOTAL COST	$3,880	$26,694

Sources:

CH2M Hill 1991.

Note:

Estimated cost of processing materials collected based on CH2M Hill (1991) Generic cost of materials recovery facility:

Generic facility capacity: 7,300 tonnes/a
Number of facilities required:

Waste processed	Waste received	Per cent recycled	Waste recycled	Facilities required
1992	71,751	91%	65,293	9
2000	491,280	92%	432,853	62

Capital cost assumptions: Facility life 20 years
Interest rate 6%

A.17 Changing product specifications

With the advent of new technologies and shifting consumer habits, products will change in specification as a result of both regulation and market forces. Changing product specifications is an umbrella category which encompasses the following:

- shifting from single use products to reusable more durable items;
- new technology, when adopted, rendering previously used materials obsolete; and
- reduction in a product's material intensity.

The goal of this measure is to provide consumers with less wasteful product alternatives.

A.17.1 Efficiency

There are small gains to be made through waste reduction from changing product specifications.

It is anticipated that alternatives such as using reusable bags for groceries, though less wasteful, will be more labour intensive. The question arises, are waste generators willing to forgo convenience? Given current education programs and growing concern for the environment, the answer is probably yes. It should be noted that these desirable habits may take time to cultivate.

A.17.2 Equity

Changing product specifications involves a shift in certain economic activities and this implies a reallocation of resources. Jobs will be lost in one sector and created in another. However, it cannot be assumed that these shifts would be equal.

A.17.3 Diversion potential

The net result of changing product specifications should be an incremental diversion of waste. It is anticipated the following adjustments will be observed (Table A-26):

- In the United Kingdom, the British Broadcasting Corporation (BBC) provides a news service call "CEEFAX". It is anticipated that the "BROADCAST NEWS" service, available through Rogers Cable, will be upgraded to allow the user greater flexibility. Also, alternative electronic news media services will be available to the IC&I sector. The net result will be a decline in ONP waste generated by 4 per cent

Table A-26
Changing product specifications diversion parameters

Waste components - residential sector	1992	2000
ONP	Reduction +4%	Reduction +8%
Boxboard	Reduction +5%	Reduction +7%
Telephone books	Reduction +5%	Reduction +9%
Plastics	Reduction +4.7%	Reduction +5.9%
Composite packaging	Reduction +7%	Reduction +12%

Waste components - IC&I sector	1992	2000
ONP	Reduction +2%	Reduction +5%
Boxboard	Reduction +7%	Reduction +12%
Telephone books	Reduction +8%	Reduction +15%
Plastics	Reduction +3.9%	Reduction +5.3%
Composite packaging	Reduction +7%	Reduction +12%

and 8 per cent in the residential, and by 2 per cent and 5 per cent in the IC&I sector over and above current projections.

- Boxboard is primarily used for packaging. It is assumed that producers will begin to offer reusable options, a shift to more recyclable cardboard. The result of such actions will be further reductions of 5 per cent and 7 per cent in the residential sector, and of 7 per cent and 12 per cent in the IC&I sector, for 1992 and 2000 respectively.

- With the personal computer revolution, electronic phone directories will be available to users. This will result in a reduction of telephone books. Reductions, for this item, of 5 per cent and 9 per cent for the residential sector, and of 8 per cent and 15 per cent for the IC&I sector, are projected for the respective target years.

- Through "light-weighting" there will be a reduction of plastic in packaging. There will also be a move away from single use plastic products towards more durable reusable items (eg: steel knives and forks). The net result will be an estimated reduction in plastic waste generated by 4.7 per cent and 5.9 per cent in the residential sector and by 3.9 per cent and 5.3 per cent in the IC&I sector.

- The content of cardboard and plastic in composite packaging will be reduced. Reductions of 7 per cent and 12 per cent, for both sectors, in composite packaging are anticipated for the respective target years.

A.18 Subsidies and incentives to producers

Subsidies and incentives (or disincentives) can be given to producers which encourage the use of recycled materials, reduce packaging or produce more durable (and reusable items). Subsidies and incentives to producers can take the form of product charges, tax incentives, research and development tax credits, or subsidies, grants and loans.

Product charges

Economic theory suggests that the cost of collecting and disposing of a discarded product should be borne by the purchaser of the product, rather than by funding from a general, fixed property tax assessment (OECD 1981:16). Product charges attempt to incorporate the cost of waste management for certain products into the cost of the product.

One approach would be for the product charge to equal the marginal cost of waste management (i.e. collection and disposal). However, waste management costs vary greatly according to product types and disposal locations. Therefore, some kind of average product charge would have to be determined, perhaps based upon some or all of the following factors:

- the product's contribution to the total waste stream;

- the difficulty and the costs involved in collecting and disposing of the product;

- the volume of the waste generated in the product's manufacture and the difficulty and cost of collecting and disposing of these wastes; and

- the environmental impact of the product or its manufacturing by-products once they reach the solid waste stream.

Product charges could be levied on a per unit basis, or on a product's weight or volume.

A tax based upon product weight would have the advantage of discouraging the use of excess packaging, but its effectiveness is diminished as the product's price/weight ratio increases.

The goal of product charges is to influence manufacturers to *design for reduction.*

Tax incentives

Tax incentives are typically geared towards encouraging recycling activities. Tax incentives for these activities come in three types: investment tax credits; sales tax exemptions; and property tax exemptions.

Investment tax credits (ITCs) allow firms to subtract a portion of the cost of qualifying capital purchases from their federal or provincial tax liability, thus reducing the net after-tax cost of capital. These tax incentives are intended to increase the capital to firms using recycled materials, boost productivity, and thus increase demand for recycled materials inputs, and divert solid waste from landfills (OTA 1989;324).

Consumption tax credits (CTCs) provide a means of reducing the cost of reclaimed materials to manufacturers. Specifically, they reduce tax liability by an amount proportional to the quantity of reclaimed material used. For such credit to be effective, two assumptions must hold (OTA 1989;327):

- taxes paid by the target industry must be high enough that credits for purchasing a favoured material can actually affect the materials's net after-credit price; and
- the primary factor in buyers' choice between competing materials must be *price*, so that a difference no larger than possible through the tax code will cause them to change their buying habits.

CTCs can be granted to manufacturers who reprocess secondary materials and also to firms that purchase from manufacturers who reprocess secondary materials or sell recycled goods. CTCs are analogous to taxes on virgin materials, where the goal is to reduce the cost of recycled inputs relative to virgin inputs.

Research and development tax credits

For a tax credit for R&D expenditures to be successful, it must meet the same criteria as any other investment tax credit (i.e. it must actually increase R&D expenditures above their previously planned level or it must reduce the cost of previously planned expenditures) (OTA 1989;329). Cost savings must be transferred to consumers, with increased sales.

It is unlikely that a tax credit for R&D for recycling will be a cost-effective method to increase the amount of solid waste recycled. Taxpayers dollars might be spent more effectively on direct subsidies to R&D organizations, such as universities, with a requirement that discoveries enter the public domain if not actually into production within a specified time (OTA 1989;329).

Subsidies, grants and loans

There are a number of reasons why governments may employ any of these three instruments to aid waste management initiatives (OTA 1989;329).

- A direct subsidy is typically for a fixed dollar amount, therefore, the cost of the program is known and can be controlled.
- Direct subsidies are administered by government ministries, who are experienced with the structure of recycling industries targeted for assistance.
- Direct subsidies can provide benefits more quickly to firms in need than can tax credits, which may take some time to be realized.
- For policy purposes, the effects of direct subsidies can be more easily determined than those associated with a more diffuse tax subsidy program.

Grants, direct loans and loan guarantees are non-tax types of financial incentives.

It is anticipated that any program of subsidies to producers would influence the waste generation of the following components:

- ONP;
- corrugated cardboard;
- telephone books;
- glass containers;
- plastics;
- composite packaging;
- aluminium cans, foil;
- tinplate, steel cans;

- food waste; and
- disposable diapers.

A.18.1 Empirical studies

There are many programs of subsidies and incentives outlined in the literature. However, there has been little evaluation of these programs as most of them are relatively new and assessment is difficult. However, a number of programs currently in operation are outlined below.

Product charges

- Under the provincial *Litter Control Act,* Saskatchewan imposes an "environmental handling charge" at the wholesale level on non-refillable aluminium and PET plastic beverage containers. The charges are two and five cents on aluminium cans and PET bottles respectively. These charges began in May, 1988, for aluminium cans, and in November, 1988, for PET bottles.

- Florida has enacted legislation that will impose a waste newsprint disposal tax of ten cents per ton and a disposal tax of one cent for all glass, plastic, metal and composite containers of not less than five ounces in capacity. Manufacturers and users of newsprint are able to claim a tax credit of ten cents for every ton of recycled newsprint they use.

- Rhode Island has enacted legislation that exempts those retailers that purchase biodegradable (i.e. paper) bags, boxes and wrapping material, and returnable containers from paying the normal sales tax.

- Iowa has passed legislation that allows a four cent retail sales and use tax levied on non-biodegradable packaging for which there is no biodegradable alternative at the point of sale by retailers. The tax will go into effect when compliance is reasonably possible. To date the tax has not gone into effect.

- Since 1969, the Federal Republic of Germany has taxed virgin oils. The main object of the tax is to ensure the safe disposal of waste oil, either through recycling or non-polluting treatment. The product charge is paid by manufacturers or importers of mineral lubricating oils, and is also paid on reprocessed oil. The rate of the tax, initially set at DM 7.50 per kg of new oil (1969-1975) was raised to DM 9 in February 1976. Since the system was introduced, the volume of waste oil disposed of dropped from 92,000 tonnes to 9,000 tonnes (OECD 1981;18-20).

Tax Incentives

Tax incentives, offered by various U.S. States are discussed below.

- The Oregon Department of Energy administers a *Business Energy Tax Credit*, which allows companies to write off, over a 5 year period, 35 per cent of the cost of any equipment used solely for recycling. Garbage haulers and supermarkets have been the primary recipients of the tax credits to date. In 1985, the legislation renewed the law until December 31, 1990. The program is popular with legislators and businesses. The effects of this program has not been assessed (OTA 1989:323).

- Oregon's *Pollution Control Facility* tax credit has been available to recycling facilities or materials recovery facilities since 1973. The credit is 50 per cent of the certified costs, which may be taken over ten years or the life of the facility if it is shorter than ten years and can be applied against corporate, individual income, and property taxes for nonprofit organizations. The *Pollution Control Facility* tax credit is used by firms that process a variety of materials, such as tires, asphalt, yard debris and wood waste, gravel, waste paper, plastics, batteries and glass[13] (OTA 1989;323-324).

In Illinois, the *Development Finance Authority Direct Loan* fund provides subordinated, fixed asset loans based on a fixed rate of interest for 7 to 25 year periods, depending on the depreciable assets purchased[14]. The loans average about $150.000 for creditworthy businesses that could not acquire conventional financing.

A.18.2 Efficiency

Theoretically, the internalization of product charges into product prices should result in efficiency gains. An analysis of the efficiency of disposal taxes for reducing waste production (within a simplified economy), found that disposal taxes not only reduce source waste reduction, but increase recycling rates as well (VHB 1991). However, from the literature surveyed, little empirical evidence of the effectiveness of product charges (and disposal taxes) was found.

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13 Examples of certified projects include a $23.8 million battery recycling plant and $13.3 million for a facility for ONP de-inking.

14 Fixed assets might include equipment, land, or building purchases. Direct loans could also be used for working capital, for example for inventory purchases. Direct loans are also usually low interest (i.e. below prime rate) and may have an extended repayment term.

Product charges have the following advantages, which may improve efficiency (OECD 1981;44):

- if imposed at the manufacturing stage, there could be a strong incentive for products to be redesigned to be less solid-waste-intensive;

- combined with a system of recycling or reclaimed material credits, product charges would act as an incentive for resource recovery and the use of reclaimed materials in manufacturing; and

- product charges do not conflict with other economic, regulatory or administrative instruments that may be implemented to improve particular aspects of solid waste management (though they do overlap with packaging charges).

Product charges will result in higher prices for those products to which they are applied. However, if product charges result in a reduction in waste generation, then social welfare can increase, both because of lowered costs of managing solid waste and the social benefits of a less polluted environment (Webb 1985;24).

As discussed previously, subsidies, grants and loans are potentially beneficial in assisting recycling industries. However, in considering efficiency, these programs present particular difficulties. Direct subsidies will increase the budget deficit if new revenue sources are not specified. Large direct subsidies, although more likely to be effective than small ones, tend to make recipients dependent on them - if the subsidy is suddenly terminated, these firms may face serious threats to their continued operation (OTA 1989;329).

Subsidies and grants may impair competition in the recycling industry. Large, inefficient companies may be artificially kept afloat through subsidies. This may preclude a large number of smaller operations from entering the market. However, the reduction in the cost of capital should reduce the cost of production, which could be then passed on as a reduction in the price of the final product (OTA 1989;324).

A.18.3 Equity

Product charges should result in a more equitable distribution of the costs of solid waste management because they insure that consumers and manufacturers bear the costs of disposing of the products that they purchase. Unfortunately, disposal taxes may impact regressively on low income families (Webb 1985;2). However, this can be eased through the provision of an income tax credit.

Subsidies and other forms of financial assistance to industry necessarily involve a transfer of funds from individual and corporate taxpayers to the recipient organizations. Such transfers

are not equitable if they do not achieve the desired response. Even if they do, there may be some question as to their fairness.

A.18.4 Diversion potential

Product charges and tax incentives do not directly reduce the quantity of waste for disposal. Product charges are implemented to persuade manufacturers to produce less waste-intensive goods and to use a higher content of reclaimed materials. Tax incentives are geared towards increasing capital to firms using recycled materials, boost productivity, and thus influence the demand for reclaimed material inputs. In both cases, the effect would be the diversion of solid waste from landfill and incineration.

As desirable as these programs may seem, there has been only a minimal effort in trying to quantify the effects of any of these instruments currently in use. The extent of these benefits, however, has not been documented in operational programs (OTA 1989;324-324).

In most cases, tax incentives do not appear to be major influences on business investment decisions and they do not necessarily lead to increased recovery of materials from the waste stream. Industry representatives indicate that such tax incentives would not be a deciding factor (OTA 1989;324-325). Other factors, such as labour costs and proximity to markets are more critical determinants of investment decisions.

Given the wide range of possible responses to product charges and subsidies, the following is a reasonable assessment of what might occur (Table A-27):

- A negative subsidy on virgin newsprint could be imposed on newsprint producers. To mitigate this added cost, it is expected that they will diversify their operations to produce newsprint with recycled fibres. It is anticipated that this will result in a 10 per cent increase in ONP diversion, in 1992 and 2000, in response to this tax.

- Subsidies and product charges will encourage producers to recycle boxboard. The recycling rates for boxboard in the residential and IC&I sectors will increase by an assumed 5 per cent and 10 per cent for 1992 and 2000 respectively.

- Producers will recycle more OCC as a result of product charges. The recycling rates for OCC in the residential sector will increase by 20 per cent and 50 per cent and in the IC&I sector by 15 per cent and 25 per cent for 1992 and 2000 respectively.

- If a product charge or a tax is imposed on telephone books, it is anticipated that Bell Canada will begin to distribute directory services electronically (through software and/or "directory terminals"). Assuming that this tax is imposed, the anticipated response is a 5 per cent and 12 per cent reduction in residential generation, and 7 per cent and 15 per cent reduction in IC&I generation for 1992 and 2000

Table A-27
Subsidies and incentives to producers diversion parameters

Waste components - residential sector	1992	2000
ONP	Recycling +10%	Recycling +10%
Boxboard	Recycling +5%	Recycling +10%
Old corrugated cardboard	Recycling +20%	Recycling +50%
Telephone books	Reduction +5%	Reduction +12%
Glass containers	Reuse +10% Recycling +21%	Reuse +20% Recycling +12%
Plastics	Recycling +3.4%	Recycling +9.3%
Composite Packaging	Reduction +6%	Reduction +12%
Aluminium cans	Recycling +36%	Recycling +27%
Tinplate steel cans	Recycling +32%	Recycling +32%
Tires	Reuse +2% Recycling +15%	Reuse +4% Recycling +3%
Diapers	Reduction +5%	Reduction +8%
Waste components - IC&I sector	**1992**	**2000**
ONP	Recycling +10%	Recycling +10%
Boxboard	Recycling +5%	Recycling +10%
Old corrugated cardboard	Recycling +15%	Recycling +25%
Telephone books	Reduction +7%	Reduction +15%
Glass containers	Reuse +5% Recycling +10%	Reuse +10% Recycling +20%
Aluminium cans	Recycling +15%	Recycling +25%
Tinplate steel cans	Recycling +15%	Recycling +25%
Tires	Reuse +2% Recycling +15%	Reuse +4% Recycling +3%
Diapers	Reduction +5%	Reduction +8%

respectively.

- A disposal tax, like a deposit, will promote greater reuse and recycling of glass containers. It is anticipated that for the residential sector reuse will increase by 10 per cent and 20 per cent, while recycling will increase by 21 per cent and 12 per cent. IC&I reuse will increase by 5 per cent and 10 per cent, and recycling will increase by 10 per cent and 20 per cent for 1992 and 2000 respectively.

- Taxes will encourage producers to be more aggressive with their plastic's recycling campaign. As a result, recycling rates for plastics will increase by 3.4 per cent and 9.3 per cent in the residential sector for the two target years.

- Taxes and subsidies will encourage producers to use less packaging. Due to higher prices, consumers will begin to seek out less packaged goods. Hence, a reduction of 6 per cent and 12 per cent in the quantity of composite packaging is assumed in the residential waste stream.

- Disposal taxes levied against aluminium sheet manufacturers will encourage a higher rate of reclaimed material use. It is anticipated that this will translate into enhanced recovery programs resulting in residential recycling rates increasing by 36 per cent and 27 per cent and IC&I recycling rates increasing by 15 per cent and 25 per cent for 1992 and 2000 respectively.

- It is anticipated that tinplate steel manufacturers will also recycle more. Tinplate steel recycling in the residential sector will increase by 32 per cent for both target years and IC&I tinplate steel recovery will increase by 15 per cent in 1992 and 25 per cent in 2000.

- A revised tax structure will levy lower taxes on used tires versus new ones. Reuse will increase by 2 per cent and 4 per cent in both the residential and IC&I sectors. Disposal taxes will encourage recycling rates to increase by 15 per cent and 3 per cent for each target year for both sectors.

- The prospect of product charges will encourage disposable diaper producers to seek lighter-weight materials, while consumers will switch to diaper services. It is anticipated that the quantity of diapers entering the solid waste stream will be reduced by 5 per cent and 8 per cent by 1992 and 2000 respectively for both sectors.

A.18.5 Implementation costs

Table A-28 presents the estimated implementation costs of subsidies and incentives to producers based on an average subsidy of $ 17.95 per tonne of waste diverted from landfill. The cost of implementing the measure is about $3.9 million in 1992 and $5.3 million in 2000.

Table A-28
Cost of subsidies to producers

Annualized cost of measure, 000's (1989$)		
CAPITAL COSTS	**1992**	**2000**
Approvals/Hearings	na	na
Site Acquisition	na	na
Equipment	na	na
Total Capital Costs	na	na
OPERATING COSTS		
Labour	na	na
Maintenance	na	na
Energy	na	na
Administration	na	na
Total Operating Costs	$3,867	$5,282
TOTAL COST	$3,867	$5,282

Sources:

Meidma 1976.
Shrybman 1989.

Note:

Average (1989$) cost of subsidies are assumed equal to the average subsidies proposed in Meidema 1976 and Shrybman 1989, or 17.95/t for waste diverted. This incentive may be provided to manufacturers or consumers of end-products for as investment or consumption credits above current trend subsidies and incentives. Funding is for a given year and assumes an equal portion of the subsidies or incentives are assigned to the operating expenses of the consumer or manufacturer.

na - not available

Appendix B Waste management policy model

Waste management policy model

B.1 Introduction

The Waste Management Policy Model (WMPM) provides:

- an analysis of the effects of these measures; and
- an estimation of the waste quantities diverted by these measures.

These three processes are handled separately by two individual *Lotus 1-2-3, Version 2.2* worksheets in the WMPM. Each worksheet relies on data created by the other. The two processes are provided as sub-programs or options from the main menu invoked when the file **MENU.WK1** is retrieved (Table B-1). Upon retrieving **MENU.WK1** the user must run the *Install* option to create and verify the location of the program and sub-directories.

The following discusses what each of these sub-programs does, and an overview of how it does it. Where appropriate a pictorial overview is provided.

B.2 OPTIONS

The **OPTIONS** sub-program (Table B-2) permits the analysis of the effects of individual measures and combined measures. The following discusses all the menu options available in **OPTIONS**.

Table B-1
MENU options for waste management policy model

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Options  Results  Tutorial  Install  Quit

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    *                    WASTE MANAGEMENT POLICY MODEL                     *
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    *                                                                      *
    *                                                                      *
    *                   VHB Research & Consulting Inc.                     *
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    *                                                                      *
    *                                                                      *
    *                          13 June 1991                                *
    *                                                                      *
    *                                                                      *
    *                                                                      *
    *                                                                      *
    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

B.2.1 Policies

The *Policies* option provides the user with the ability to select up to eight measures for analysis (Table B-3). *Policies* creates a split-screen with two windows: the one on the right window the available measures (up to eighteen); the window on the left shows the current measures selected. Individual measures are selected by entering the number of the desired measure shown in the right-hand window. To leave a policy option as is, simply press <enter> and the cursor moves down to the next slot.

A measure can only be selected once. Choosing a measure number that has already been selected results in an error tone, and the input is not accepted.

Secondary factors (see below) are reset to default values after policies are chosen. As this may not be desired, the user is asked to confirm the measure policy selection process before actually making choices.

Table B-2
OPTIONS sub-program — waste management policy model

```
Policies  Secondaries  Analyze  Utilities  Input-Output  Link  Quit

     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
     *                                                                     *
     *                                                                     *
     *                                                                     *
     *               ----------------------------------------              *
     *                           Policy Evaluator                          *
     *               ----------------------------------------              *
     *                                                                     *
     *         This does something wonderful, I hope you enjoy it.         *
     *                                                                     *
     *                                                                     *
     *                  VHB Research & Consulting Inc.                     *
     *                                                                     *
     *                                                                     *
     *                                                                     *
     *                             24 May 1991                             *
     *                                                                     *
     *                                                                     *
     *                                                                     *
     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

B.2.2 Secondaries

Secondaries allows the user to set the policies' ranks, substitute/complement factors, and measure efficiencies. These are discussed individually below and presented in Table B-4.

Policy Ranks

The order of measure selection is important. Generally, the measure selected first has the most "weight". Also, the substitutional/complementary nature (see below) of measures is relative to the first measure on the list.

After the completion of the *Policies* selection routine (Table 4), the chosen group of measures is ranked in the order of selection. This ranking may be changed through the *Secondaries/Policy Ranks/Set* menu item. Rankings may also be reset to the order of selection through *Secondaries/Policy Ranks/Initialize* item. Measure ranks are arbitrary, with higher numbers having more rank than lower numbers. The highest rank for any measure is 8. A measure can be temporarily removed from the analysis be setting its rank to zero. To restore the measure, reset measure ranks by using the *Initialize* sub-menu.

Table B-3
Policies selection option — waste management policy model

```
Choose a number from the menu provided; 0=default; <enter>=no change; -ve=quit
Please enter number -

* * * * * * * * * * * * * * * * *       ¿ ¿ ¿ ¿  *** POLICY OPTIONS *** ¿ ¿ ¿ ¿
*                                       ¿     1 DEPOSIT SYSTEMS
*  Choose the policies you wish         ¿     2 EDUCATION PROGRAMS
*  to invoke (TAX INCENTIVES,           ¿     3 EXPANDED BLUE BOX PROGRAMS
*  USER CHARGES, etc.).                 ¿     4 INCREASE MUNICIPAL FUNDING
*  Insert the number of your            ¿     5 INDUSTRIAL WASTE AUDITS
*  choice in the space provided         ¿     6 LANDFILL BANS
*  below. You have a maximum of         ¿     7 LANDFILL TIPPING FEES
*  eight choices.                       ¿     8 MANDATORY PROCESSING OF SOLID WA
*                                       ¿     9 MANDATORY SOURCE SEPARATION
*  1.    LANDFILL TIPPING FEES          ¿    10 PACKAGING TAXES
*  2.    EXPANDED BLUE BOX PROGRA       ¿    11 PRODUCT BANS
*  3.    LANDFILL BANS                  ¿    12 PRODUCT SPECIFICATIONS
*  4.    PRODUCT SPECIFICATIONS         ¿    13 RECYCLED CONTENT REGULATION
*  5.    VIRGIN MATERIALS TAXES         ¿    14 SUBSIDISED HOME COMPOSTERS
*  6.    INCREASE MUNICIPAL FUNDI       ¿    15 USER CHARGES
*  7.    PRODUCT BANS                   ¿    16 VIRGIN MATERIALS TAXES
*  8.     *** POLICY OPTIONS ***        ¿    17 YARD AND ORGANIC WASTE COLLECTIO
*                                       ¿    18 SUBSIDIES TO PRODUCERS
* * * * * * * * * * * * * * * * *       ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿ ¿
```

Factors

Some measures complement others, while some are pure substitutes. When two measures are substitutes, the model selects the measure with the higher diversion parameter. When two measures are complements, the diversion parameters are combined using one of several formulae that can be chosen by the user. The model provides the ability to change the effects of complementary measures.

After selecting a group of policies, or changing a set of *Policy Ranks*, all complementary measure factors are initialized to 100 per cent. Normally, this need not be changed. However, the *Factors* option provides the ability to change the complement/substitute relationship between measures. Choosing *Secondaries/Factors/Initialize* sets all factors to 100 per cent, while *Secondaries/Factors/Set* allows for their modification.

Efficiencies

The effectiveness of any given measure can be globally improved or reduced by altering its efficiency. All diversion parameters for all sectors and years are multiplied by this efficiency (normally 100 per cent) before the final analysis.

Table B-4
Policies rankings and efficiencies — waste management policy model

```
                                        Select Ranks, press <enter> when done

 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
 *      POLICY RANKINGS AND EFFICIENCIES                                   *
 *                                                                         *
 *      Ranking is done in reverse order (i.e. assign 8 for                *
 *      the most important policy, then 7, 6 etc.) Set rank                *
 *      to 0 to ignore policy.                                             *
 *      Efficiencies must lie between zero (0) and one (1).                *
 *                                                                         *
 *      Policies                        Menu    Rank    Efficiency         *
 *                                                                         *
 * 1.   LANDFILL TIPPING FEES              7       8       100%            *
 * 2.   EXPANDED BLUE BOX PROGRAMS         3       7       100%            *
 * 3.   LANDFILL BANS                      6       6       100%            *
 * 4.   PRODUCT SPECIFICATIONS            12       5       100%            *
 * 5.   VIRGIN MATERIALS TAXES            16       4       100%            *
 * 6.   INCREASE MUNICIPAL FUNDING         4       3       100%            *
 * 7.   PRODUCT BANS                      11       2       100%            *
 * 8.                                                                      *
 *                                                                         *
 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

The efficiency factor for each measure may be set by the user. Typically, the user would set the efficiency for each measure somewhere between 0 and 1 (0 per cent and 100 per cent efficiency). However the efficiency of a measure can be set in excess of 100 per cent or less than 0 per cent. For example, the user may wish to examine a measure's effect if the diversion for all waste types and sectors were 200 per cent, or double the diversion specified for the measure in the model.

Unlike *Factors*, changing measure ranks does not reset the efficiencies (they are initialized when new policies are selected). Choosing *Secondaries/Efficiencies/Initialize* does initialize the policies' efficiencies (Table B-4). Selecting *Secondaries/Efficiencies/Set* allows for their modification.

B.2.3 Analyze

Once all measures are selected and ranked, complementary factors and efficiencies set as desired, the user can finally analyze the cumulative effects of combined measures as a policy scenario.

The process results in one set of diversion parameters for all waste streams, sectors and years. This data may then be exported (see below), for quantitative analysis, *Viewing* and *Printing*.

Analyze may be interrupted by pressing the escape key (<esc>). The routine will ask if the user really wants to abort, or continue *Analyzing* where the program left off (ie. prior to the <esc> press).

B.2.4 Utilities

Several options are provided under *Utilities.*

Formulae

There are a number of ways in which the substitutional/complementary effects of measures may be considered. As users may have their own views about this, the ability to change the method is provided here.

Four formulae are provided: each treats complementary measures differently. The four options are presented under *Utilities/Formulae* with a short description (Table B-5). The model is provided with option number three, *Substitutes with remainder complements* as the default, as this seems the most rational. The user selects the number corresponding to the preferred evaluation formulae.

Table

The substitutional/complementary aspects of measures is defined in *Table* B-6. It is a symmetric table consisting of the letters "S" and "C", implying substitutes or complements, respectively.

Selecting *Utilities/Table* puts the user in a window where half of the factors may be edited (given the table's symmetry, the other half are determined automatically) (Table B-6). In the WMPM the determination of the complement/substitute relationship between two measures was determined based on the following:

1) Do the measures affect the same sectors? — If No...substitutes

2) Do the measures affect any of the same waste components? — If No...substitutes

   If Yes, is it only one waste component?

   If No, is there one principal waste component that both measures affect? — If No...Go to 4).

3) Do the measures affect the same portion

Table B-5
Evaluation formulae options — waste management policy model

```
1.  2.  3.  4.  Help  Return
Set to 'Substitutes with remainder complements.'

   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
   *                                                                     *
   *                ----------------------------------------             *
   *                         Evaluation Formulae.                        *
   *                ----------------------------------------             *
   *                                                                     *
   *        Available methods for evaluating policy effects:             *
   *                                                                     *
   *   1.   @if(@tri  Substitutes with remainder complements: eff-      *
   *                  ectiveness of complementary policy reduced by      *
   *                  diversion "so far".                                *
   *   2.   @if(@tri  Substitutes with perfect complements: each        *
   *                  complementary policy is additive.                  *
   *   3.   @if(@abs  Substitutes only: policies are never additive.    *
   *   4.   LASTEFFE  Complements only: policy effects are additive.    *
   *                                                                     *
   *           Note:  Complementary Policy Factors are always            *
   *                  applied, regardless of formula chosen.             *
   *                                                                     *
   * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

of the one waste component?	If No...complements
If Yes, is their *combined* effect additive?	If Yes...complements If No...substitutes
4) In general, do the measures affect the same portions of the waste components?	If No...complements
If Yes, is their *combined* effect additive?	If Yes...complements If No...substitutes

The user may reset the complement/substitute relationship between two measures based on other criteria.

Table B-6
Complements/substitutes matrix — waste management policy model

Select S/C, press <enter> when done

Substitute-Complement Table - Symmetric, but not case-sensitive.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DEPOSIT SYSTEMS	1	S	C	S	C	S	S	S	C	S	S	S	S	S	S	S	S	S	S
EDUCATION PROGR	2	C	S	C	C	C	S	C	C	C	C	S	C	C	C	C	C	C	C
EXPANDED BLUE B	3	S	C	S	S	S	S	S	C	S	C	S	C	S	C	S	S	S	C
INCREASE MUNICI	4	C	C	S	S	S	S	S	S	S	C	S	C	S	S	S	S	S	C
INDUSTRIAL WAST	5	S	C	S	S	S	S	S	C	S	C	C	C	C	S	S	S	S	S
LANDFILL BANS	6	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
LANDFILL TIPPIN	7	S	C	S	S	S	S	S	S	S	C	C	S	S	S	S	S	S	S
MANDATORY PROCE	8	C	C	C	S	C	S	S	S	C	S	S	S	S	S	S	S	S	S
MANDATORY SOURC	9	S	C	S	S	S	S	S	C	S	C	C	C	C	S	S	S	S	S
PACKAGING TAXES	10	S	C	C	C	C	S	C	S	C	S	S	S	C	S	C	S	S	C
PRODUCT BANS	11	S	S	S	S	C	S	C	S	C	S	S	S	C	S	C	C	S	S
PRODUCT SPECIFI	12	S	C	C	C	C	S	S	S	C	S	S	S	S	S	S	S	S	S
RECYCLED CONTEN	13	S	C	S	S	C	S	S	S	C	C	C	S	S	S	S	S	S	S
SUBSIDISED HOME	14	S	C	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
USER CHARGES	15	S	C	S	S	S	S	S	S	S	C	C	S	S	S	S	S	S	S
VIRGIN MATERIAL	16	S	C	S	S	S	S	S	S	S	S	C	S	S	S	S	S	S	S
YARD AND ORGANI	17	S	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
SUBSIDIES TO PR	18	S	C	C	C	S	S	S.	S	S	C	S	S	S	S	S	S	S	S

B.2.5 Input-Output

All disk operations are handled by this sub-menu. The items are discussed individually below.

Extract

The *Analyze*d effects of combined measures may be extracted.

By selecting *Input-Output/Extract/Model* the results may be quantitatively examined in terms of tonnes of waste diverted, results *View*ed and *Print*ed. This menu option stores the extracted file in a sub-directory that only the **RESULTS** sub-program reads.

The user is prompted for a measure name and description.

Save

The user may *Save* the current settings of **OPTIONS** if desired.

B.2.6 Link

Link returns the user to the starting menu of the model.

The user is warned if the link would cause the loss of modified data. That is, if changes are made and *Save* is not executed, then the program warns the user.

B.2.7 Quit

Quit permits the user to exit the **OPTIONS** sub-program.

B.3 RESULTS

Once measure groups have been *Analyze*d and *Extract*ed through the **OPTIONS** sub-program, the quantitative effect of diverting wastes can be examined in the **RESULTS** sub-program (Table B-7). The individual menu options are discussed below.

B.3.1 View

After *Import*ing **OPTIONS** results (see below), **RESULTS** calculates the quantity of waste sent to each waste management option, in each sector, for all years (in tonnes). *View* provides two options: *Summary* results for the policy(s) or a *Comparison* of the results with the current trend or other policy results imported through the *Comparison* option (see below) (Table B-8).

Since there are a great number of individual results (i.e., four waste management options for twenty-two waste types, in four sectors and two years), viewing the entire set was deemed too overwhelming a task for both the programmers, and the viewers. For detailed results, the user is asked to *Print* (see below).

Table B-7
RESULTS sub-program — waste management policy model

```
View  Import  Save  Link  Print  Extract  Compare  Quit

    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
    *                                                                     *
    *                 ----------------------------------------            *
    *                        POLICY RESULTS EVALUATOR                     *
    *                 ----------------------------------------            *
    *                                                                     *
    *                                                                     *
    *       This spreadsheet quantifies the diversion scenario            *
    *       calculated in OPTIONS. The costs and revenues resulting       *
    *       from the scenario are also estimated. Results may be          *
    *       viewed on-screen or dumped to the printer.                    *
    *                                                                     *
    *                                                                     *
    *                                                                     *
    *                             23 March 1992                           *
    *                                                                     *
    *                                                                     *
    *                                                                     *
    *                                                                     *
    * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

B.3.2 Import

The effects of individual or combined measures, analyzed by **OPTIONS** are *Import*ed through this menu option. This data is specified in percentages. **RESULTS** calculates the actual physical quantities of waste by waste type, sector and year.

Import permits the user to *View* and *Print* all individual and combined policy scenarios extracted from **OPTIONS**. The user either gets the updated listing of possible policy scenarios or chooses from the list of policy options previously imported and saved in the **RESULTS** sub-program (the user selects *Import\Don't*).

B.3.3 Save

There really is not much reason for the user to *Save* the **RESULTS** file. Since its primary functions are *Import*, *View*, and *Print*, these can be done quickly, over and over again. However, the *Save* option is provided since the user may want to *Import* now, and *Print* or *View* later.

Table B-8
View option of summary and comparison results — waste management policy model

Summary results:

Press F10 to Exit

SCENARIO: CURRENT TREND

	1987	1989	1992	2000
RECYCLING				
Received		583 082	1 182 123	2 103 055
Recycled		539 804	1 082 728	1 924 150
Incineration				
Solid Waste Management		43 278	99 396	178 905
Total Diversion		539 804	1 082 728	1 924 150
Percent Diversion	0	93%	92%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 075 379	8 798 736	8 596 742	8 349 975
Incineration				
Landfill	9 075 379	8 798 736	8 596 742	8 349 975
Sent to Recycling				
Percent Diversion	0	0	0	0
SUMMARY - ALL WASTE				
Total Waste Generated	9 075 379	9 409 200	9 824 245	10 681 000
Total Waste Diverted		610 464	1 227 503	2 331 024
Percent of Waste Diverted	0	6%	12%	22%

Comparison results:

Press F10 to Exit

COMPARISON:	CURRENT TREND 1992	vs. 2000	CURRENT TREND 1992	2000
RECYCLING				
Received for Recycling	1 182 123	2 103 055	1 182 123	2 103 055
Recycled	1 082 728	1 924 150	1 082 728	1 924 150
Incineration				
Landfill	99 396	178 905	99 396	178 905
Total Diversion	1 082 728	1 924 150	1 082 728	1 924 150
Percent Diversion	92%	91%	92%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	8 596 742	8 349 975	8 596 742	8 349 975
Incineration				
Landfill	8 596 742	8 349 975	8 596 742	8 349 975
Sent to Recycling				
Percent Diversion	0	0%	0%	0
SUMMARY - ALL WASTE				
Total Waste Generated	9 824 245	10 681 000	9 824 245	10 681 000
Total Waste Diversion	1 227 503	2 331 024	1 227 503	2 331 024
Percent of Waste Diver	12%	22%	12%	22%

B.3.4 Link

Link returns the user to the starting menu of the model. The user is warned if the link would cause the loss of modified data. That is, if changes are made and *Save* is not executed, then the program warns the user.

B.3.5 Print

Four *Print* options are provided in the WMPM and are discussed below. For each option, the user is asked if output should be directed directly to the printer or to a file.

All output is formatted by the *Lotus* add-in program *Allways*. The program assumes that *Allways* has been correctly configured for the printer available.

Diversions

Detailed tables of the raw percentages calculated by **OPTIONS** are printed. This takes the place of a print function in *OPTIONS*. The output is approximately two letter-size pages long.

Results

Detailed tables of the actual quantities going to each waste management option for each waste stream, sector, and year are printed. The output is approximately ten pages long.

Summary

This output is identical to the four screens shown by the *View* menu choice. It requires two pages to print.

Comparison

This output is identical to the four screens shown by the *View* menu *Comparison* option. It requires two pages to print.

B.3.6 Extract

Extract extracts the combined policies scenario *Import*ed into **RESULTS** to a disk file for *Comparison* with other WMPM **OPTIONS** policy analysis (see below). By selecting *Extract* the results may be quantitatively examined in terms of tonnes of waste diverted with other model results. This menu option stores the extracted file in a sub-directory that only the **RESULTS** sub-program reads.

B.3.7 Compare

The effects of combined measures, analyzed by **RESULTS** and *Extract*ed are imported through *Compare* for comparison with the *Import*ed policy results. Typically this is the current trend on which all policy scenarios are applied. However, the user may choose any *Extract*ed results for comparison.

The user *Import*s the policy *Extract*ed from **RESULTS** for comparison. The user either *Get*s the updated listing of possible *Extract*ed policy results or chooses from the list of policy results previously *Extract*ed and *Save*d in the **RESULTS** sub-program (the user selects *Compare\Don't*).

B.3.8 Quit

Quit permits the user to exit the **RESULTS** sub-program.

B.4 Tutorial

The *Tutorial* option of **MENU.WK1** provides a brief overview of the objective and function of the model.

B.5 Install

Upon retrieving **MENU.WK1** for the first time the user must run the *Install* option to create and verify the location of the program and sub-directories. If the user has previously used and saved the WMPM, the *Install* option does not have to be invoked.

B.6 Quit

The *Quit* option allows the user to leave the model and return to *LOTUS 1-2-3, version 2.2*. The user must leave the model to exit *LOTUS 1-2-3*.

Appendix C Detailed scenario results

NOTE: In the following tables two costs are presented, *Waste Management Costs* and *Policy Implementation Costs* (incremental program costs). Total waste management costs equal the sum of *Waste Management Costs* plus total *Policy Implementation Costs* for each scenario.

Current trend

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		74%	18%	8%		86%	7%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			1%	99%			2%	98%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-14%		6%	107%	-74%		41%	133%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		21%	77%	-5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		32%		60%	5%		30%		65%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%				99%	-2%				102%
OCC	1%		30%		69%	-2%		51%		51%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		21%		77%			20%		80%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	87 329	90 755
Reuse				
Recycled		232 562	649 802	1 249 966
Landfill	3 915 076	3 811 163	3 494 859	3 260 332
Total Diversion		242 037	737 131	1 340 721
Percent Diversion	0%	6%	17%	29%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			126 451	75 565
Reuse				
Recycled		241 693	564 750	1 069 924
Incineration				
Landfill	5 178 308	5 119 307	4 958 470	4 841 372
Total Diversion		241 693	691 201	1 145 489
Percent Diversion	0%	5%	12%	19%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 328 934	2 538 396
Recycled		474 255	1 214 552	2 319 890
Incineration				
Landfill		30 243	114 382	218 506
Total Diversion		474 255	1 214 552	2 319 890
Percent Diversion	0%	94%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 453 329	8 101 704
Incineration				
Landfill	9 093 384	8 930 470	8 453 329	8 101 704
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 428 331	2 486 210
Percent of Waste Diverted	0%	5%	14%	23%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$204 745	$71 706	$133 039
Incineration			
Landfill	$710 092		$710 092
TOTAL	$914 836	$71 706	$843 130

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$393 487	$127 085	$266 402
Incineration			
Landfill	$680 555		$680 555
TOTAL	$1 074 042	$127 085	$946 957

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

COMPARISON: CURRENT TREND vs. CURRENT TREND

	1992	2000	1992	2000
RESIDENTIAL				
Generation	4 231 989	4 601 053	4 231 989	4 601 053
Reduction	87 329	90 755	87 329	90 755
Reuse				
Sent to Recycling	649 802	1 249 966	649 802	1 249 966
Landfill	3 494 859	3 260 332	3 494 859	3 260 332
Total Diversion	737 131	1 340 721	737 131	1 340 721
Percent Diversion	17%	29%	17%	29%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 649 671	5 986 861	5 649 671	5 986 861
Reduction	126 451	75 565	126 451	75 565
Reuse				
Sent to Recycling	564 750	1 069 924	564 750	1 069 924
Incineration				
Landfill	4 958 470	4 841 372	4 958 470	4 841 372
Total Diversion	691 201	1 145 489	691 201	1 145 489
Percent Diversion	12%	19%	12%	19%

	1992	2000	1992	2000
RECYCLING				
Received for Recycling	1 328 934	2 538 396	1 328 934	2 538 396
Recycled	1 214 552	2 319 890	1 214 552	2 319 890
Incineration				
Landfill	114 382	218 506	114 382	218 506
Total Diversion	1 214 552	2 319 890	1 214 552	2 319 890
Percent Diversion	91%	91%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	8 453 329	8 101 704	8 453 329	8 101 704
Incineration				
Landfill	8 453 329	8 101 704	8 453 329	8 101 704
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 881 660	10 587 914	9 881 660	10 587 914
Total Waste Diversion	1 428 331	2 486 210	1 428 331	2 486 210
Percent of Waste Diverted	14%	23%	14%	23%

Source: Waste Management Policy Model

COMPARISON: CURRENT TREND vs. CURRENT TREND

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	CURRENT TREND	CURRENT TREND	DIFFERENCE
Reduction			
Reuse			
Recycling	$133 039	$133 039	
Incineration			
Landfill	$710 092	$710 092	
TOTAL	$843 130	$843 130	

INCREMENTAL POLICY IMPLEMENTATION	CURRENT TREND	CURRENT TREND	DIFFERENCE
vs.			
vs.			
vs.			
vs.			
vs.			
vs.			
vs.			
vs.			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	CURRENT TREND	CURRENT TREND	DIFFERENCE
Reduction			
Reuse			
Recycling	$266 402	$266 402	
Incineration			
Landfill	$680 555	$680 555	
TOTAL	$946 957	$946 957	

INCREMENTAL POLICY IMPLEMENTATION	CURRENT TREND	CURRENT TREND	DIFFERENCE
vs.			
vs.			
vs.			
vs.			
vs.			
vs.			
vs.			
vs.			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: CURRENT TREND

TABLE 1

SUMMARY - ALL WASTE TYPES

	1987	1989	1992	2000
	Tonnes			
Total Waste Generated Residential and I.C.I	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted from Landfill and Incineration		483 730	1 428 331	2 486 210
Total Waste Sent to Landfill and Incineration	9 093 384	8 930 470	8 453 329	8 101 704
Reference Quantity	9 093 384	9 414 200	9 829 466	10 686 675
Proportion of Waste Diverted From Landfill and Incineration		5%	14%	23%
Waste Diverted from Landfill and Incineration as a Proportion of Waste Sent to Landfill and Incineration in 1987		5%	15%	23%
Waste Management and Policy Implementation Costs				
	000's of 1989 Dollars			
Cost of Diversions			$133 039	$266 402
Cost of Landfill and Incineration			$710 092	$680 555
Total Waste Management Cost			$843 130	$946 957
Cost of Policies				

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: CURRENT TREND

TABLE 2a Waste Quantities Generated

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP	386 369	400 000	417 644	454 066
Fine Paper	71 478	74 000	77 264	84 002
Boxboard	167 201	173 100	180 736	196 497
OCC	105 286	109 000	113 808	123 733
Mixed Paper	57 279	59 300	61 916	67 315
Magazines	159 474	165 100	172 383	187 416
Telephone Books	12 557	13 000	13 573	14 757
Glass Containers	259 350	268 500	280 344	304 792
Plastic (rigid and film)	132 911	137 600	143 670	156 199
Composite Packaging	11 012	11 400	11 903	12 941
Aluminium Cans, Foil	15 841	16 400	17 123	18 617
Tinplate, Steel Cans	72 541	75 100	78 413	85 251
White Goods	97 945	101 400	105 873	115 106
Used Tires	773	800	835	908
Yard Waste	632 099	654 400	683 266	742 852
Food Waste	603 315	624 600	652 151	709 024
Wood Waste	45 109	46 700	48 760	53 012
Construction/Demolition Waste	11 108	11 500	12 007	13 054
Disposable Diapers	107 217	111 000	115 896	126 003
Foundry Sands				
Asphalt				
Other	966 212	1 000 300	1 044 424	1 135 506
TOTAL	3 915 076	4 053 200	4 231 989	4 601 053
Total Residential Waste Diverted from Solid Waste Management Stream		242 037	737 131	1 340 721
Proportion of Residential Waste Diverted from Landfill and Incineration		6%	17%	29%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: CURRENT TREND

TABLE 2b Reduction

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP			32 644	34 066
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books			1 250	1 365
Glass Containers			3 744	5 292
Plastic (rigid and film)			-19 410	-114 951
Composite Packaging				
Aluminium Cans, Foil			5 188	6 332
Tinplate, Steel Cans			-20 687	-13 849
White Goods				
Used Tires				
Yard Waste		2 369	16 800	38 400
Food Waste		7 106	50 400	115 200
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers			17 400	18 900
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Reduced		9 475	87 329	90 755
Proportion of Residential Waste Stream		0%	2%	2%
Proportion of Total Waste Stream		0%	1%	1%
Waste Diverted through Reduction as a Proportion of Waste Sent to Landfill and Incineration in 1987		0%	1%	1%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: CURRENT TREND

TABLE 2c Reuse

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP				
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books				
Glass Containers				
Plastic (rigid and film)				
Composite Packaging				
Aluminium Cans, Foil				
Tinplate, Steel Cans				
White Goods				
Used Tires				
Yard Waste				
Food Waste				
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Reused				
Proportion of Residential Waste Stream				
Proportion of Total Waste Stream				
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987				

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: CURRENT TREND

TABLE 2d Recycling

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP		155 900	307 800	390 000
Fine Paper			19 365	42 100
Boxboard			36 150	98 235
OCC		830	1 200	2 800
Mixed Paper				
Magazines		260	14 964	52 675
Telephone Books		750	1 185	5 000
Glass Containers		31 000	87 000	140 000
Plastic (rigid and film)		1 030	8 690	64 100
Composite Packaging				
Aluminium Cans, Foil		3 130	4 820	6 600
Tinplate, Steel Cans		16 140	58 000	70 000
White Goods				
Used Tires				
Yard Waste		38 764	142 769	425 050
Food Waste			14 427	50 120
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Sent		247 804	696 370	1 346 680
Waste Actually Recycled		232 562	649 802	1 249 966
Proportion of Residential Waste Stream		6%	15%	27%
Proportion of Total Waste Stream		2%	7%	12%
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987		3%	7%	14%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: CURRENT TREND

TABLE 3a — Waste Quantities Generated

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP	164 207	170 000	179 154	189 846
Fine Paper	347 732	360 000	379 385	402 028
Boxboard	322 521	333 900	351 879	372 881
OCC	425 972	441 000	464 746	492 484
Mixed Paper	76 694	79 400	83 675	88 669
Magazines	123 252	127 600	134 471	142 496
Telephone Books	7 051	7 300	7 693	8 152
Glass Containers	59 404	61 500	64 812	68 680
Plastic (rigid and film)	98 814	102 300	107 808	114 243
Composite Packaging				
Aluminium Cans, Foil	16 131	16 700	17 599	18 650
Tinplate, Steel Cans	23 762	24 600	25 925	27 472
White Goods				
Used Tires	85 001	88 000	92 738	98 273
Yard Waste	106 251	110 000	115 923	122 842
Food Waste	473 302	490 000	516 385	547 204
Wood Waste	1 390 638	1 439 700	1 517 223	1 607 775
Construction/Demolition Waste	125 184	129 600	136 579	144 730
Disposable Diapers	7 727	8 000	8 431	8 934
Foundry Sands	343 868	356 000	375 169	397 561
Asphalt				
Other	980 797	1 015 400	1 070 076	1 133 941
TOTAL	5 178 308	5 361 000	5 649 671	5 986 861
Total ICI Waste Diverted from Solid Waste Management Stream		241 693	691 201	1 145 489
Proportion of ICI Waste Diverted from Landfill and Incineration		5%	12%	19%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: CURRENT TREND

TABLE 3b Reduction

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP			14 154	9 846
Fine Paper			41 318	116 169
Boxboard			3 184	-6 119
OCC			3 846	-8 616
Mixed Paper				-1 451
Magazines			1 401	-2 104
Telephone Books			685	745
Glass Containers			1 412	
Plastic (rigid and film)			-15 552	-88 057
Composite Packaging				
Aluminium Cans, Foil			3 939	4 830
Tinplate, Steel Cans			-14 675	-13 128
White Goods				
Used Tires				-2 227
Yard Waste			1 923	-1 158
Food Waste			4 385	-9 796
Wood Waste			13 923	-26 625
Construction/Demolition Waste			46 079	60 330
Disposable Diapers			1 260	1 365
Foundry Sands			19 169	41 561
Asphalt				
Other				
Total ICI Waste Reduced			126 451	75 565
Proportion of ICI Waste Stream			2%	1%
Proportion of Total Waste Stream			1%	1%
Waste Diverted through Reduction as a Proportion of Waste Sent to Landfill and Incineration in 1987			1%	1%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: CURRENT TREND

TABLE 3c Reuse

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP				
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books				
Glass Containers				
Plastic (rigid and film)				
Composite Packaging				
Aluminium Cans, Foil				
Tinplate, Steel Cans				
White Goods				
Used Tires				
Yard Waste				
Food Waste				
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total ICI Waste Reused				
Proportion of ICI Waste Stream				
Proportion of Total Waste Stream				
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987				

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: CURRENT TREND

TABLE 3d Recycling

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP		57 000	57 000	57 000
Fine Paper		30 000	45 737	81 289
Boxboard				
OCC		110 300	138 300	250 500
Mixed Paper			15 700	15 700
Magazines				
Telephone Books				
Glass Containers		16 800	13 400	13 400
Plastic (rigid and film)			11 620	45 700
Composite Packaging				
Aluminium Cans, Foil		5 434	6 445	6 679
Tinplate, Steel Cans		60	9 512	11 480
White Goods				
Used Tires		6 100	14 700	61 400
Yard Waste				
Food Waste		30 000	95 450	159 768
Wood Waste			188 000	328 000
Construction/Demolition Waste		1 000	34 100	53 200
Disposable Diapers				
Foundry Sands			2 600	107 600
Asphalt				
Other				
Total ICI Waste Sent to Recycling		256 694	632 564	1 191 716
Waste Actually Recycled		241 693	564 750	1 069 924
Proportion of ICI Waste Stream		5%	10%	18%
Proportion of Total Waste Stream		3%	6%	10%
Waste Diverted through Recycling as a Proportion of Waste Sent to Landfill and Incineration in 1987		3%	6%	12%

Source: Waste Management Policy Model

Ontario's waste reduction action plan

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		77%	15%	8%		88%	5%
Fine Paper			36%	64%			63%	37%
Boxboard			28%	72%			60%	40%
OCC			20%	80%			37%	63%
Mixed Paper				100%				100%
Magazines			20%	80%			41%	59%
Telephone Books	9%		17%	74%	9%		43%	48%
Glass Containers	1%		42%	57%	2%		57%	41%
Plastic (rigid and film)	-14%		22%	92%	-74%		80%	94%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		38%	31%	34%		44%	22%
Tinplate, Steel Cans	-26%		85%	41%	-16%		90%	26%
White Goods				100%				100%
Used Tires		2%		98%		2%		98%
Yard Waste	2%		44%	54%	5%		81%	14%
Food Waste	24%		2%	74%	32%		7%	61%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	27%			73%	31%			69%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other	6%			94%	4%			96%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	8%		42%		50%	5%		49%		46%
Fine Paper	11%		27%		62%	29%		37%		34%
Boxboard	1%		13%		87%	-2%		24%		77%
OCC	1%		49%		50%	-2%		66%		35%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%		5%		94%	-1%		10%		91%
Telephone Books	9%		9%		82%	9%		16%		75%
Glass Containers	2%		27%		71%			30%		70%
Plastic (rigid and film)	-14%		24%		91%	-77%		68%		109%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		40%		37%	26%		42%		32%
Tinplate, Steel Cans	-57%		52%		105%	-48%		60%		88%
White Goods					100%					100%
Used Tires			24%		76%	-2%		66%		36%
Yard Waste	2%		12%		87%	-1%		28%		73%
Food Waste	1%		29%		70%	-2%		47%		55%
Wood Waste	1%		24%		75%	-2%		35%		67%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	19%				81%	19%				81%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other	15%				85%	14%				86%

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	271 697	270 963
Reuse			17	18
Recycled		232 562	925 045	1 606 351
Landfill	3 915 076	3 811 163	3 035 230	2 723 721
Total Diversion		242 037	1 196 759	1 877 332
Percent Diversion	0%	6%	28%	41%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			291 601	230 084
Reuse				
Recycled		241 693	1 018 774	1 706 726
Incineration				
Landfill	5 178 308	5 119 307	4 339 296	4 050 052
Total Diversion		241 693	1 310 375	1 936 809
Percent Diversion	0%	5%	23%	32%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	2 123 088	3 617 478
Recycled		474 255	1 943 819	3 313 077
Incineration				
Landfill		30 243	179 269	304 402
Total Diversion		474 255	1 943 819	3 313 077
Percent Diversion	0%	94%	92%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	7 374 526	6 773 772
Incineration				
Landfill	9 093 384	8 930 470	7 374 526	6 773 772
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	2 507 134	3 814 142
Percent of Waste Diverted	0%	5%	25%	36%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$326 700	$110 039	$216 661
Incineration			
Landfill	$619 471		$619 471
TOTAL	$946 171	$110 039	$836 132

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
MANDATORY SOURCE SEPARATION			
INDUSTRIAL WASTE AUDITS			
YARD AND ORGANIC WASTE COLLECTION PROGRAMS		$4 987	$4 987
EDUCATION PROGRAMS		$14 368	$14 368
EXPANDED BLUE BOX PROGRAMS		$8 591	$8 591
TOTAL IMPLEMENTATION COSTS		$27 946	$27 946

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$564 233	$188 254	$375 979
Incineration			
Landfill	$569 007		$569 007
TOTAL	$1 133 240	$188 254	$944 986

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
MANDATORY SOURCE SEPARATION			
INDUSTRIAL WASTE AUDITS			
YARD AND ORGANIC WASTE COLLECTION PROGRAMS		$7 895	$7 895
EDUCATION PROGRAMS		$16 118	$16 118
EXPANDED BLUE BOX PROGRAMS		$13 837	$13 837
TOTAL IMPLEMENTATION COSTS		$37 850	$37 850

Source: Waste Management Policy Model

COMPARISON: ONTARIO'S WAST vs. CURRENT TREND

	1992	2000	1992	2000
RESIDENTIAL				
Generation	4 231 989	4 601 053	4 231 989	4 601 053
Reduction	271 697	270 963	87 329	90 755
Reuse	17	18		
Sent to Recycling	925 045	1 606 351	649 802	1 249 966
Landfill	3 035 230	2 723 721	3 494 859	3 260 332
Total Diversion	1 196 759	1 877 332	737 131	1 340 721
Percent Diversion	28%	41%	17%	29%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 649 671	5 986 861	5 649 671	5 986 861
Reduction	291 601	230 084	126 451	75 565
Reuse				
Sent to Recycling	1 018 774	1 706 726	564 750	1 069 924
Incineration				
Landfill	4 339 296	4 050 052	4 958 470	4 841 372
Total Diversion	1 310 375	1 936 809	691 201	1 145 489
Percent Diversion	23%	32%	12%	19%

	1992	2000	1992	2000
RECYCLING				
Received for Recycling	2 123 088	3 617 478	1 328 934	2 538 396
Recycled	1 943 819	3 313 077	1 214 552	2 319 890
Incineration				
Landfill	179 269	304 402	114 382	218 506
Total Diversion	1 943 819	3 313 077	1 214 552	2 319 890
Percent Diversion	92%	92%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	7 374 526	6 773 772	8 453 329	8 101 704
Incineration				
Landfill	7 374 526	6 773 772	8 453 329	8 101 704
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 881 660	10 587 914	9 881 660	10 587 914
Total Waste Diversion	2 507 134	3 814 142	1 428 331	2 486 210
Percent of Waste Diverted	25%	36%	14%	23%

Source: Waste Management Policy Model

COMPARISON: ONTARIO'S WAST vs. CURRENT TREND

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	ONTARIO'S WASTE	CURRENT TREND	DIFFERENCE
Reduction			
Reuse			
Recycling	$216 661	$133 039	$83 623
Incineration			
Landfill	$619 471	$710 092	-$90 621
TOTAL	$836 132	$843 130	-$6 998

INCREMENTAL POLICY IMPLEMENTATION	ONTARIO'S WASTE	CURRENT TREND	DIFFERENCE
MANDATORY SOURCE SEPARATION vs.			
INDUSTRIAL WASTE AUDITS vs.			
YARD AND ORGANIC WASTE COLLECTION PRO	$4 987		$4 987
EDUCATION PROGRAMS vs.	$14 368		$14 368
EXPANDED BLUE BOX PROGRAMS vs.	$8 591		$8 591
vs.			
vs.			
vs.			
TOTAL IMPLEMENTATION COSTS	$27 946		$27 946

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	ONTARIO'S WASTE	CURRENT TREND	DIFFERENCE
Reduction			
Reuse			
Recycling	$375 979	$266 402	$109 577
Incineration			
Landfill	$569 007	$680 555	-$111 548
TOTAL	$944 986	$946 957	-$1 971

INCREMENTAL POLICY IMPLEMENTATION	ONTARIO'S WASTE	CURRENT TREND	DIFFERENCE
MANDATORY SOURCE SEPARATION vs.			
INDUSTRIAL WASTE AUDITS vs.			
YARD AND ORGANIC WASTE COLLECTION PRO	$7 895		$7 895
EDUCATION PROGRAMS vs.	$16 118		$16 118
EXPANDED BLUE BOX PROGRAMS vs.	$13 837		$13 837
vs.			
vs.			
vs.			
TOTAL IMPLEMENTATION COSTS	$37 850		$37 850

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ONTARIO'S WASTE REDUCTION ACTION PLAN SCENARIO

TABLE 1

SUMMARY - ALL WASTE TYPES

	1987	1989	1992	2000
	Tonnes			
Total Waste Generated Residential and I.C.I	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted from Landfill and Incineration		483 730	2 507 134	3 814 142
Total Waste Sent to Landfill and Incineration	9 093 384	8 930 470	7 374 526	6 773 772
Reference Quantity	9 093 384	9 414 200	9 829 466	10 686 675
Proportion of Waste Diverted From Landfill and Incineration		5%	25%	36%
Waste Diverted from Landfill and Incineration as a Proportion of Waste Sent to Landfill and Incineration in 1987		5%	26%	36%
Waste Management and Policy Implementation Costs				
	000's of 1989 Dollars			
Cost of Diversions			$216 661	$375 979
Cost of Landfill and Incineration			$619 471	$569 007
Total Waste Management Cost			$836 132	$944 986
Cost of Policies			$27 946	$37 850

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ONTARIO'S WASTE REDUCTION ACTION PLAN SCENARIO

TABLE 2a Waste Quantities Generated

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP	386 369	400 000	417 644	454 066
Fine Paper	71 478	74 000	77 264	84 002
Boxboard	167 201	173 100	180 736	196 497
OCC	105 286	109 000	113 808	123 733
Mixed Paper	57 279	59 300	61 916	67 315
Magazines	159 474	165 100	172 383	187 416
Telephone Books	12 557	13 000	13 573	14 757
Glass Containers	259 350	268 500	280 344	304 792
Plastic (rigid and film)	132 911	137 600	143 670	156 199
Composite Packaging	11 012	11 400	11 903	12 941
Aluminium Cans, Foil	15 841	16 400	17 123	18 617
Tinplate, Steel Cans	72 541	75 100	78 413	85 251
White Goods	97 945	101 400	105 873	115 106
Used Tires	773	800	835	908
Yard Waste	632 099	654 400	683 266	742 852
Food Waste	603 315	624 600	652 151	709 024
Wood Waste	45 109	46 700	48 760	53 012
Construction/Demolition Waste	11 108	11 500	12 007	13 054
Disposable Diapers	107 217	111 000	115 896	126 003
Foundry Sands				
Asphalt				
Other	966 212	1 000 300	1 044 424	1 135 506
TOTAL	3 915 076	4 053 200	4 231 989	4 601 053
Total Residential Waste Diverted from Solid Waste Management Stream		242 037	1 196 759	1 877 332
Proportion of Residential Waste Diverted from Landfill and Incineration		6%	28%	41%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ONTARIO'S WASTE REDUCTION ACTION PLAN SCENARIO

TABLE 2b Reduction

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP			32 644	34 066
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books			1 250	1 365
Glass Containers			3 744	5 292
Plastic (rigid and film)			-19 410	-114 951
Composite Packaging				
Aluminium Cans, Foil			5 188	6 332
Tinplate, Steel Cans			-20 687	-13 849
White Goods				
Used Tires				
Yard Waste		2 369	16 800	38 400
Food Waste		7 106	157 880	229 595
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers			31 623	39 292
Foundry Sands				
Asphalt				
Other			62 665	45 420
Total Residential Waste Reduced		9 475	271 697	270 963
Proportion of Residential Waste Stream		0%	6%	6%
Proportion of Total Waste Stream		0%	3%	3%
Waste Diverted through Reduction as a Proportion of Waste Sent to Landfill and Incineration in 1987		0%	3%	3%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ONTARIO'S WASTE REDUCTION ACTION PLAN SCENARIO

TABLE 2c Reuse

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP				
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books				
Glass Containers				
Plastic (rigid and film)				
Composite Packaging				
Aluminium Cans, Foil				
Tinplate, Steel Cans				
White Goods				
Used Tires			17	18
Yard Waste				
Food Waste				
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Reused			17	18
Proportion of Residential Waste Stream			0%	0%
Proportion of Total Waste Stream			0%	0%
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987			0%	0%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ONTARIO'S WASTE REDUCTION ACTION PLAN SCENARIO

TABLE 2d Recycling

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP		155 900	322 499	397 368
Fine Paper			28 050	52 576
Boxboard			50 609	118 752
OCC		830	22 879	45 852
Mixed Paper				
Magazines		260	34 767	77 144
Telephone Books		750	2 299	6 343
Glass Containers		31 000	118 094	173 734
Plastic (rigid and film)		1 030	30 984	124 217
Composite Packaging				
Aluminium Cans, Foil		3 130	6 585	8 146
Tinplate, Steel Cans		16 140	66 610	76 591
White Goods				
Used Tires				
Yard Waste		38 764	297 260	599 397
Food Waste			14 427	50 120
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Sent		247 804	995 063	1 730 240
Waste Actually Recycled		232 562	925 045	1 606 351
Proportion of Residential Waste Stream		6%	22%	35%
Proportion of Total Waste Stream		2%	9%	15%
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987		3%	10%	18%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ONTARIO'S WASTE REDUCTION ACTION PLAN SCENARIO

TABLE 3a Waste Quantities Generated

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP	164 207	170 000	179 154	189 846
Fine Paper	347 732	360 000	379 385	402 028
Boxboard	322 521	333 900	351 879	372 881
OCC	425 972	441 000	464 746	492 484
Mixed Paper	76 694	79 400	83 675	88 669
Magazines	123 252	127 600	134 471	142 496
Telephone Books	7 051	7 300	7 693	8 152
Glass Containers	59 404	61 500	64 812	68 680
Plastic (rigid and film)	98 814	102 300	107 808	114 243
Composite Packaging				
Aluminium Cans, Foil	16 131	16 700	17 599	18 650
Tinplate, Steel Cans	23 762	24 600	25 925	27 472
White Goods				
Used Tires	85 001	88 000	92 738	98 273
Yard Waste	106 251	110 000	115 923	122 842
Food Waste	473 302	490 000	516 385	547 204
Wood Waste	1 390 638	1 439 700	1 517 223	1 607 775
Construction/Demolition Waste	125 184	129 600	136 579	144 730
Disposable Diapers	7 727	8 000	8 431	8 934
Foundry Sands	343 868	356 000	375 169	397 561
Asphalt				
Other	980 797	1 015 400	1 070 076	1 133 941
TOTAL	5 178 308	5 361 000	5 649 671	5 986 861
Total ICI Waste Diverted from Solid Waste Management Stream		241 693	1 310 375	1 936 809
Proportion of ICI Waste Diverted from Landfill and Incineration		5%	23%	32%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ONTARIO'S WASTE REDUCTION ACTION PLAN SCENARIO

TABLE 3b Reduction

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP			14 154	9 846
Fine Paper			41 318	116 169
Boxboard			3 184	-6 119
OCC			3 846	-8 616
Mixed Paper				-1 451
Magazines			1 401	-2 104
Telephone Books			685	745
Glass Containers			1 412	
Plastic (rigid and film)			-15 552	-88 057
Composite Packaging				
Aluminium Cans, Foil			3 939	4 830
Tinplate, Steel Cans			-14 675	-13 128
White Goods				
Used Tires				-2 227
Yard Waste			1 923	-1 158
Food Waste			4 385	-9 796
Wood Waste			13 923	-26 625
Construction/Demolition Waste			46 079	60 330
Disposable Diapers			1 619	1 668
Foundry Sands			19 169	41 561
Asphalt				
Other			164 792	154 216
Total ICI Waste Reduced			291 601	230 084
Proportion of ICI Waste Stream			5%	4%
Proportion of Total Waste Stream			3%	2%
Waste Diverted through Reduction as a Proportion of Waste Sent to Landfill and Incineration in 1987			3%	3%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ONTARIO'S WASTE REDUCTION ACTION PLAN SCENARIO

TABLE 3c Reuse

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP				
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books				
Glass Containers				
Plastic (rigid and film)				
Composite Packaging				
Aluminium Cans, Foil				
Tinplate, Steel Cans				
White Goods				
Used Tires				
Yard Waste				
Food Waste				
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total ICI Waste Reused				
Proportion of ICI Waste Stream				
Proportion of Total Waste Stream				
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987				

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ONTARIO'S WASTE REDUCTION ACTION PLAN SCENARIO

TABLE 3d Recycling

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP		57 000	75 036	92 363
Fine Paper		30 000	102 011	147 774
Boxboard			44 284	90 960
OCC		110 300	228 628	327 434
Mixed Paper			15 700	15 700
Magazines			6 654	14 460
Telephone Books			722	1 300
Glass Containers		16 800	17 325	20 365
Plastic (rigid and film)			25 680	77 205
Composite Packaging				
Aluminium Cans, Foil		5 434	7 084	7 787
Tinplate, Steel Cans		60	13 460	16 532
White Goods				
Used Tires		6 100	22 309	65 212
Yard Waste			13 452	33 790
Food Waste		30 000	152 101	258 282
Wood Waste			366 881	557 273
Construction/Demolition Waste		1 000	34 100	53 200
Disposable Diapers				
Foundry Sands			2 600	107 600
Asphalt				
Other				
Total ICI Waste Sent to Recycling		256 694	1 128 025	1 887 238
Waste Actually Recycled		241 693	1 018 774	1 706 726
Proportion of ICI Waste Stream		5%	18%	29%
Proportion of Total Waste Stream		3%	10%	16%
Waste Diverted through Recycling as a Proportion of Waste Sent to Landfill and Incineration in 1987		3%	11%	19%

Source: Waste Management Policy Model

Economic measures scenario

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		78%	14%	8%		88%	5%
Fine Paper			34%	66%			59%	41%
Boxboard			35%	65%			64%	36%
OCC			40%	60%			68%	32%
Mixed Paper				100%				100%
Magazines			16%	84%			37%	63%
Telephone Books	9%		17%	74%	9%		46%	45%
Glass Containers	1%		63%	35%	2%		74%	24%
Plastic (rigid and film)	-14%		22%	92%	-74%		80%	93%
Composite Packaging	11%		7%	82%	21%		10%	69%
Aluminium Cans, Foil	30%		55%	15%	34%		53%	13%
Tinplate, Steel Cans	-26%		97%	30%	-16%		98%	18%
White Goods				100%				100%
Used Tires			22%	78%			14%	86%
Yard Waste	25%		21%	54%	27%		57%	16%
Food Waste	19%		2%	78%	32%		7%	61%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	30%			70%	43%			57%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other	5%			95%	5%			95%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		43%		49%	5%		48%		47%
Fine Paper	11%		24%		65%	29%		35%		36%
Boxboard	1%		10%		89%	-2%		15%		86%
OCC	1%		60%		39%	-2%		79%		22%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%		8%		83%	9%		17%		73%
Glass Containers	2%		45%		53%			60%		40%
Plastic (rigid and film)	-14%		20%		94%	-77%		63%		114%
Composite Packaging	8%		5%		87%	15%		7%		78%
Aluminium Cans, Foil	22%		45%		32%	26%		50%		24%
Tinplate, Steel Cans	-57%		60%		97%	-48%		76%		72%
White Goods					100%					100%
Used Tires			35%		65%	-2%		68%		34%
Yard Waste	11%				89%	19%				81%
Food Waste	13%		18%		69%	24%		29%		47%
Wood Waste	1%		21%		78%	-2%		33%		69%
Construction/Demolition Waste	34%		27%		40%	42%		38%		20%
Disposable Diapers	23%				77%	27%				73%
Foundry Sands	7%		1%		92%	15%		27%		58%
Asphalt					100%					100%
Other	5%				95%	5%				95%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	392 075	461 848
Reuse				
Recycled		232 562	880 293	1 541 216
Landfill	3 915 076	3 811 163	2 959 621	2 597 989
Total Diversion		242 037	1 272 368	2 003 064
Percent Diversion	0%	6%	30%	44%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			261 622	314 541
Reuse				
Recycled		241 693	959 258	1 591 173
Incineration				
Landfill	5 178 308	5 119 307	4 428 790	4 081 147
Total Diversion		241 693	1 220 881	1 905 714
Percent Diversion	0%	5%	22%	32%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	2 001 824	3 411 011
Recycled		474 255	1 839 551	3 132 389
Incineration				
Landfill		30 243	162 272	278 622
Total Diversion		474 255	1 839 551	3 132 389
Percent Diversion	0%	94%	92%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	7 388 411	6 679 136
Incineration				
Landfill	9 093 384	8 930 470	7 388 411	6 679 136
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	2 493 249	3 908 778
Percent of Waste Diverted	0%	5%	25%	37%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$314 514	$129 469	$185 045
Incineration			
Landfill	$620 637		$620 637
TOTAL	$935 151	$129 469	$805 682

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
INCREASE MUNICIPAL FUNDING		$35 362	$35 362
SUBSIDIES TO PRODUCERS		$3 867	$3 867
DEPOSIT SYSTEMS			
LANDFILL TIPPING FEES			
SUBSIDISED HOME COMPOSTERS	$430		$430
PACKAGING TAXES			
USER CHARGES			
VIRGIN MATERIALS TAXES			
TOTAL IMPLEMENTATION COSTS	$430	$39 229	$39 659

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$540 405	$210 270	$330 135
Incineration			
Landfill	$561 057		$561 057
TOTAL	$1 101 462	$210 270	$891 192

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
INCREASE MUNICIPAL FUNDING		$44 742	$44 742
SUBSIDIES TO PRODUCERS		$5 282	$5 282
DEPOSIT SYSTEMS			
LANDFILL TIPPING FEES			
SUBSIDISED HOME COMPOSTERS	$1 370		$1 370
PACKAGING TAXES			
USER CHARGES			
VIRGIN MATERIALS TAXES			
TOTAL IMPLEMENTATION COSTS	$1 370	$50 024	$51 394

Source: Waste Management Policy Model

COMPARISON: ECONOMIC MEASU vs. CURRENT TREND

	1992	2000	1992	2000
RESIDENTIAL				
Generation	4 231 989	4 601 053	4 231 989	4 601 053
Reduction	392 075	461 848	87 329	90 755
Reuse				
Sent to Recycling	880 293	1 541 216	649 802	1 249 966
Landfill	2 959 621	2 597 989	3 494 859	3 260 332
Total Diversion	1 272 368	2 003 064	737 131	1 340 721
Percent Diversion	30%	44%	17%	29%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 649 671	5 986 861	5 649 671	5 986 861
Reduction	261 622	314 541	126 451	75 565
Reuse				
Sent to Recycling	959 258	1 591 173	564 750	1 069 924
Incineration				
Landfill	4 428 790	4 081 147	4 958 470	4 841 372
Total Diversion	1 220 881	1 905 714	691 201	1 145 489
Percent Diversion	22%	32%	12%	19%

	1992	2000	1992	2000
RECYCLING				
Received for Recycling	2 001 824	3 411 011	1 328 934	2 538 396
Recycled	1 839 551	3 132 389	1 214 552	2 319 890
Incineration				
Landfill	162 272	278 622	114 382	218 506
Total Diversion	1 839 551	3 132 389	1 214 552	2 319 890
Percent Diversion	92%	92%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	7 388 411	6 679 136	8 453 329	8 101 704
Incineration				
Landfill	7 388 411	6 679 136	8 453 329	8 101 704
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 881 660	10 587 914	9 881 660	10 587 914
Total Waste Diversion	2 493 249	3 908 778	1 428 331	2 486 210
Percent of Waste Diverted	25%	37%	14%	23%

Source: Waste Management Policy Model

COMPARISON: ECONOMIC MEASU vs. CURRENT TREND

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	ECONOMIC MEASUR	CURRENT TREND	DIFFERENCE
Reduction			
Reuse			
Recycling	$185 045	$133 039	$52 006
Incineration			
Landfill	$620 637	$710 092	-$89 455
TOTAL	$805 682	$843 130	-$37 449

INCREMENTAL POLICY IMPLEMENTATION	ECONOMIC MEASUR	CURRENT TREND	DIFFERENCE
INCREASE MUNICIPAL FUNDING vs.	$35 362		$35 362
SUBSIDIES TO PRODUCERS vs.	$3 867		$3 867
DEPOSIT SYSTEMS vs.			
LANDFILL TIPPING FEES vs.			
SUBSIDISED HOME COMPOSTERS vs.	$430		$430
PACKAGING TAXES vs.			
USER CHARGES vs.			
VIRGIN MATERIALS TAXES vs.			
TOTAL IMPLEMENTATION COSTS	$39 659		$39 659

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	ECONOMIC MEASUR	CURRENT TREND	DIFFERENCE
Reduction			
Reuse			
Recycling	$330 135	$266 402	$63 733
Incineration			
Landfill	$561 057	$680 555	-$119 498
TOTAL	$891 192	$946 957	-$55 765

INCREMENTAL POLICY IMPLEMENTATION	ECONOMIC MEASUR	CURRENT TREND	DIFFERENCE
INCREASE MUNICIPAL FUNDING vs.	$44 742		$44 742
SUBSIDIES TO PRODUCERS vs.	$5 282		$5 282
DEPOSIT SYSTEMS vs.			
LANDFILL TIPPING FEES vs.			
SUBSIDISED HOME COMPOSTERS vs.	$1 370		$1 370
PACKAGING TAXES vs.			
USER CHARGES vs.			
VIRGIN MATERIALS TAXES vs.			
TOTAL IMPLEMENTATION COSTS	$51 394		$51 394

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC MEASURES SCENARIO

TABLE 1

SUMMARY - ALL WASTE TYPES

	Tonnes 1987	1989	1992	2000
Total Waste Generated Residential and I.C.I	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted from Landfill and Incineration		483 730	2 493 249	3 908 778
Total Waste Sent to Landfill and Incineration	9 093 384	8 930 470	7 388 411	6 679 136
Reference Quantity	9 093 384	9 414 200	9 829 466	10 686 675
Proportion of Waste Diverted From Landfill and Incineration		5%	25%	37%
Waste Diverted from Landfill and Incineration as a Proportion of Waste Sent to Landfill and Incineration in 1987		5%	25%	37%
Waste Management and Policy Implementation Costs				
	000's of 1989 Dollars			
Cost of Diversions			$185 045	$330 135
Cost of Landfill and Incineration			$620 637	$561 057
Total Waste Management Cost			$805 682	$891 192
Cost of Policies			$39 659	$51 394

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC MEASURES SCENARIO

TABLE 2a Waste Quantities Generated

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP	386 369	400 000	417 644	454 066
Fine Paper	71 478	74 000	77 264	84 002
Boxboard	167 201	173 100	180 736	196 497
OCC	105 286	109 000	113 808	123 733
Mixed Paper	57 279	59 300	61 916	67 315
Magazines	159 474	165 100	172 383	187 416
Telephone Books	12 557	13 000	13 573	14 757
Glass Containers	259 350	268 500	280 344	304 792
Plastic (rigid and film)	132 911	137 600	143 670	156 199
Composite Packaging	11 012	11 400	11 903	12 941
Aluminium Cans, Foil	15 841	16 400	17 123	18 617
Tinplate, Steel Cans	72 541	75 100	78 413	85 251
White Goods	97 945	101 400	105 873	115 106
Used Tires	773	800	835	908
Yard Waste	632 099	654 400	683 266	742 852
Food Waste	603 315	624 600	652 151	709 024
Wood Waste	45 109	46 700	48 760	53 012
Construction/Demolition Waste	11 108	11 500	12 007	13 054
Disposable Diapers	107 217	111 000	115 896	126 003
Foundry Sands				
Asphalt				
Other	966 212	1 000 300	1 044 424	1 135 506
TOTAL	3 915 076	4 053 200	4 231 989	4 601 053
Total Residential Waste Diverted from Solid Waste Management Stream		242 037	1 272 368	2 003 064
Proportion of Residential Waste Diverted from Landfill and Incineration		6%	30%	44%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC MEASURES SCENARIO

TABLE 2b Reduction

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP			32 644	34 066
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books			1 250	1 365
Glass Containers			3 744	5 292
Plastic (rigid and film)			-19 410	-114 951
Composite Packaging			1 335	2 767
Aluminium Cans, Foil			5 188	6 332
Tinplate, Steel Cans			-20 687	-13 849
White Goods				
Used Tires				
Yard Waste		2 369	173 909	200 442
Food Waste		7 106	126 752	229 362
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers			35 129	54 247
Foundry Sands				
Asphalt				
Other			52 221	56 775
Total Residential Waste Reduced		9 475	392 075	461 848
Proportion of Residential Waste Stream		0%	9%	10%
Proportion of Total Waste Stream		0%	4%	4%
Waste Diverted through Reduction as a Proportion of Waste Sent to Landfill and Incineration in 1987		0%	-4%	5%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC MEASURES SCENARIO

TABLE 2c Reuse

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP				
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books				
Glass Containers				
Plastic (rigid and film)				
Composite Packaging				
Aluminium Cans, Foil				
Tinplate, Steel Cans				
White Goods				
Used Tires				
Yard Waste				
Food Waste				
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Reused				
Proportion of Residential Waste Stream				
Proportion of Total Waste Stream				
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987				

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC MEASURES SCENARIO

TABLE 2d Recycling

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP		155 900	324 552	398 130
Fine Paper			26 313	49 223
Boxboard			63 296	125 713
OCC		830	45 342	84 369
Mixed Paper				
Magazines		260	27 557	68 844
Telephone Books		750	2 271	6 746
Glass Containers		31 000	177 632	225 530
Plastic (rigid and film)		1 030	31 586	125 284
Composite Packaging			834	1 291
Aluminium Cans, Foil		3 130	9 370	9 898
Tinplate, Steel Cans		16 140	75 708	83 784
White Goods				
Used Tires			187	131
Yard Waste		38 764	142 769	425 050
Food Waste			14 427	50 120
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Sent		247 804	941 845	1 654 114
Waste Actually Recycled		232 562	880 293	1 541 216
Proportion of Residential Waste Stream		6%	21%	33%
Proportion of Total Waste Stream		2%	9%	15%
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987		3%	10%	17%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC MEASURES SCENARIO

TABLE 3a — Waste Quantities Generated

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP	164 207	170 000	179 154	189 846
Fine Paper	347 732	360 000	379 385	402 028
Boxboard	322 521	333 900	351 879	372 881
OCC	425 972	441 000	464 746	492 484
Mixed Paper	76 694	79 400	83 675	88 669
Magazines	123 252	127 600	134 471	142 496
Telephone Books	7 051	7 300	7 693	8 152
Glass Containers	59 404	61 500	64 812	68 680
Plastic (rigid and film)	98 814	102 300	107 808	114 243
Composite Packaging				
Aluminium Cans, Foil	16 131	16 700	17 599	18 650
Tinplate, Steel Cans	23 762	24 600	25 925	27 472
White Goods				
Used Tires	85 001	88 000	92 738	98 273
Yard Waste	106 251	110 000	115 923	122 842
Food Waste	473 302	490 000	516 385	547 204
Wood Waste	1 390 638	1 439 700	1 517 223	1 607 775
Construction/Demolition Waste	125 184	129 600	136 579	144 730
Disposable Diapers	7 727	8 000	8 431	8 934
Foundry Sands	343 868	356 000	375 169	397 561
Asphalt				
Other	980 797	1 015 400	1 070 076	1 133 941
TOTAL	5 178 308	5 361 000	5 649 671	5 986 861
Total ICI Waste Diverted from Solid Waste Management Stream		241 693	1 220 881	1 905 714
Proportion of ICI Waste Diverted from Landfill and Incineration		5%	22%	32%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC MEASURES SCENARIO

TABLE 3b Reduction

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP			14 154	9 846
Fine Paper			41 318	116 169
Boxboard			3 184	-6 119
OCC			3 846	-8 616
Mixed Paper				-1 451
Magazines			1 401	-2 104
Telephone Books			685	745
Glass Containers			1 412	
Plastic (rigid and film)			-15 552	-88 057
Composite Packaging				
Aluminium Cans, Foil			3 939	4 830
Tinplate, Steel Cans			-14 675	-13 128
White Goods				
Used Tires				-2 227
Yard Waste			13 323	23 642
Food Waste			66 868	129 235
Wood Waste			13 923	-26 625
Construction/Demolition Waste			46 079	60 330
Disposable Diapers			1 977	2 425
Foundry Sands			26 237	58 949
Asphalt				
Other			53 504	56 697
Total ICI Waste Reduced			261 622	314 541
Proportion of ICI Waste Stream			5%	5%
Proportion of Total Waste Stream			3%	3%
Waste Diverted through Reduction as a Proportion of Waste Sent to Landfill and Incineration in 1987			3%	3%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC MEASURES SCENARIO

TABLE 3c Reuse

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP				
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books				
Glass Containers				
Plastic (rigid and film)				
Composite Packaging				
Aluminium Cans, Foil				
Tinplate, Steel Cans				
White Goods				
Used Tires				
Yard Waste				
Food Waste				
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total ICI Waste Reused				
Proportion of ICI Waste Stream				
Proportion of Total Waste Stream				
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987				

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC MEASURES SCENARIO

TABLE 3d Recycling

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP		57 000	77 520	91 440
Fine Paper		30 000	89 587	142 660
Boxboard			34 870	56 850
OCC		110 300	281 018	391 149
Mixed Paper			15 700	15 700
Magazines				
Telephone Books			653	1 426
Glass Containers		16 800	29 081	41 090
Plastic (rigid and film)			21 985	72 505
Composite Packaging				
Aluminium Cans, Foil		5 434	7 957	9 375
Tinplate, Steel Cans		60	15 496	20 944
White Goods				
Used Tires		6 100	32 177	67 046
Yard Waste				
Food Waste		30 000	95 450	159 768
Wood Waste			319 530	523 960
Construction/Demolition Waste		1 000	36 356	55 384
Disposable Diapers				
Foundry Sands			2 600	107 600
Asphalt				
Other				
Total ICI Waste Sent to Recycling		256 694	1 059 979	1 756 897
Waste Actually Recycled		241 693	959 258	1 591 173
Proportion of ICI Waste Stream		5%	17%	27%
Proportion of Total Waste Stream		3%	10%	15%
Waste Diverted through Recycling as a Proportion of Waste Sent to Landfill and Incineration in 1987		3%	11%	17%

Source: Waste Management Policy Model

Regulatory measures scenario

Waste Diversion Percentages by Sector and Component

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%		81%	11%	8%		89%	3%
Fine Paper			50%	50%			76%	24%
Boxboard			34%	66%			68%	32%
OCC			51%	49%			79%	21%
Mixed Paper				100%				100%
Magazines			26%	74%			48%	52%
Telephone Books	9%		21%	70%	9%		46%	45%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-14%		26%	88%	-74%		93%	80%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires			10%	90%			15%	85%
Yard Waste	2%		64%	33%	5%		88%	7%
Food Waste	24%		2%	74%	32%		7%	61%
Wood Waste			20%	80%			30%	70%
Construction/Demolition Waste				100%				100%
Disposable Diapers	31%			69%	42%			58%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other	6%			94%	5%			95%

	1992					2000				
ICI	Reduction	Reuse	Recycle	Inciner-ation	Landfill	Reduction	Reuse	Recycle	Inciner-ation	Landfill
ONP	8%		55%		37%	5%		69%		26%
Fine Paper	11%		39%		50%	29%		48%		23%
Boxboard	1%		17%		82%	-2%		31%		71%
OCC	1%		71%		28%	-2%		86%		16%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%		5%		94%	-1%		10%		91%
Telephone Books	9%		9%		82%	9%		16%		75%
Glass Containers	2%		21%		77%			20%		80%
Plastic (rigid and film)	-14%		29%		85%	-77%		76%		101%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		47%		31%	26%		50%		24%
Tinplate, Steel Cans	-57%		62%		94%	-48%		74%		74%
White Goods					100%					100%
Used Tires			28%		72%	-2%		69%		33%
Yard Waste	2%		27%		72%	-1%		48%		53%
Food Waste	1%		38%		61%	-2%		62%		40%
Wood Waste	1%		43%		56%	-2%		54%		48%
Construction/Demolition Waste	34%		31%		35%	42%		41%		17%
Disposable Diapers	28%				72%	36%				64%
Foundry Sands	5%		4%		90%	10%		30%		59%
Asphalt					100%					100%
Other	19%				81%	19%				81%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992			2000		
Solid Waste Management	Recycle	Incineration	Landfill	Recycle	Incineration	Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard	7%		93%	40%		60%
OCC			100%			100%
Mixed Paper	7%		93%	40%		60%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers	5%		95%	33%		67%
Plastic (rigid and film)	3%		97%	22%		78%
Composite Packaging			100%			100%
Aluminium Cans, Foil	5%		95%	75%		25%
Tinplate, Steel Cans	5%		95%	75%		25%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

	1992			2000		
Recycling	Recycle	Incineration	Landfill	Recycle	Incineration	Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	276 277	295 513
Reuse				
Recycled		232 562	1 106 802	1 742 948
Landfill	3 915 076	3 811 163	2 848 910	2 562 592
Total Diversion		242 037	1 383 079	2 038 461
Percent Diversion	0%	6%	33%	44%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			330 841	292 906
Reuse				
Recycled		241 693	1 526 638	2 289 963
Incineration				
Landfill	5 178 308	5 119 307	3 792 192	3 403 992
Total Diversion		241 693	1 857 479	2 582 869
Percent Diversion	0%	5%	33%	43%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	2 947 202	4 782 610
Recycled		474 255	2 691 033	4 383 910
Incineration				
Landfill		30 243	256 168	398 700
Total Diversion		474 255	2 691 033	4 383 910
Percent Diversion	0%	94%	91%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	6 641 102	5 966 583
Incineration				
Landfill	9 093 384	8 930 470	6 583 508	5 615 585
Sent to Recycling			57 594	350 999
Percent Diversion	0%	0%	1%	6%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	3 298 152	4 972 329
Percent of Waste Diverted	0%	5%	33%	47%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$447 220	$133 547	$313 673
Incineration			
Landfill	$557 862		$557 862
TOTAL	$1 005 082	$133 547	$871 535

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
EDUCATION PROGRAMS		$14 368	$14 368
LANDFILL BANS			
YARD AND ORGANIC WASTE COLLECTION PROGRAMS		$4 987	$4 987
INDUSTRIAL WASTE AUDITS			
MANDATORY PROCESSING OF SOLID WASTE	$658	$3 222	$3 880
EXPANDED BLUE BOX PROGRAMS		$8 591	$8 591
MANDATORY SOURCE SEPARATION			
RECYCLED CONTENT REGULATION			
TOTAL IMPLEMENTATION COSTS	$658	$31 168	$31 826

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$748 101	$262 153	$485 947
Incineration			
Landfill	$501 201		$501 201
TOTAL	$1 249 302	$262 153	$987 149

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
EDUCATION PROGRAMS		$16 118	$16 118
LANDFILL BANS			
YARD AND ORGANIC WASTE COLLECTION PROGRAMS		$7 895	$7 895
INDUSTRIAL WASTE AUDITS			
MANDATORY PROCESSING OF SOLID WASTE	$4 529	$22 165	$26 694
EXPANDED BLUE BOX PROGRAMS		$13 837	$13 837
MANDATORY SOURCE SEPARATION			
RECYCLED CONTENT REGULATION			
TOTAL IMPLEMENTATION COSTS	$4 529	$60 015	$64 544

Source: Waste Management Policy Model

COMPARISON: REGULATORY MEA vs. CURRENT TREND

	REGULATORY MEA 1992	REGULATORY MEA 2000	CURRENT TREND 1992	CURRENT TREND 2000
RESIDENTIAL				
Generation	4 231 989	4 601 053	4 231 989	4 601 053
Reduction	276 277	295 513	87 329	90 755
Reuse				
Sent to Recycling	1 106 802	1 742 948	649 802	1 249 966
Landfill	2 848 910	2 562 592	3 494 859	3 260 332
Total Diversion	1 383 079	2 038 461	737 131	1 340 721
Percent Diversion	33%	44%	17%	29%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 649 671	5 986 861	5 649 671	5 986 861
Reduction	330 841	292 906	126 451	75 565
Reuse				
Sent to Recycling	1 526 638	2 289 963	564 750	1 069 924
Incineration				
Landfill	3 792 192	3 403 992	4 958 470	4 841 372
Total Diversion	1 857 479	2 582 869	691 201	1 145 489
Percent Diversion	33%	43%	12%	19%

	1992	2000	1992	2000
RECYCLING				
Received for Recycling	2 947 202	4 782 610	1 328 934	2 538 396
Recycled	2 691 033	4 383 910	1 214 552	2 319 890
Incineration				
Landfill	256 168	398 700	114 382	218 506
Total Diversion	2 691 033	4 383 910	1 214 552	2 319 890
Percent Diversion	91%	92%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	6 641 102	5 966 583	8 453 329	8 101 704
Incineration				
Landfill	6 583 508	5 615 585	8 453 329	8 101 704
Sent to Recycling	57 594	350 999		
Percent Diversion	1%	6%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 881 660	10 587 914	9 881 660	10 587 914
Total Waste Diversion	3 298 152	4 972 329	1 428 331	2 486 210
Percent of Waste Diverted	33%	47%	14%	23%

Source: Waste Management Policy Model

COMPARISON: REGULATORY MEA vs. CURRENT TREND

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	REGULATORY MEAS	CURRENT TREND	DIFFERENCE
Reduction			
Reuse			
Recycling	$313 673	$133 039	$180 634
Incineration			
Landfill	$557 862	$710 092	-$152 230
TOTAL	$871 535	$843 130	$28 405

INCREMENTAL POLICY IMPLEMENTATION	REGULATORY MEAS	CURRENT TREND	DIFFERENCE
EDUCATION PROGRAMS vs.	$14 368		$14 368
LANDFILL BANS vs.			
YARD AND ORGANIC WASTE COLLECTION PRO	$4 987		$4 987
INDUSTRIAL WASTE AUDITS vs.			
MANDATORY PROCESSING OF SOLID WASTE CO	$3 880		$3 880
EXPANDED BLUE BOX PROGRAMS vs.	$8 591		$8 591
MANDATORY SOURCE SEPARATION vs.			
RECYCLED CONTENT REGULATION vs.			
TOTAL IMPLEMENTATION COSTS	$31 826		$31 826

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	REGULATORY MEAS	CURRENT TREND	DIFFERENCE
Reduction			
Reuse			
Recycling	$485 947	$266 402	$219 545
Incineration			
Landfill	$501 201	$680 555	-$179 353
TOTAL	$987 149	$946 957	$40 192

INCREMENTAL POLICY IMPLEMENTATION	REGULATORY MEAS	CURRENT TREND	DIFFERENCE
EDUCATION PROGRAMS vs.	$16 118		$16 118
LANDFILL BANS vs.			
YARD AND ORGANIC WASTE COLLECTION PRO	$7 895		$7 895
INDUSTRIAL WASTE AUDITS vs.			
MANDATORY PROCESSING OF SOLID WASTE CO	$26 694		$26 694
EXPANDED BLUE BOX PROGRAMS vs.	$13 837		$13 837
MANDATORY SOURCE SEPARATION vs.			
RECYCLED CONTENT REGULATION vs.			
TOTAL IMPLEMENTATION COSTS	$64 544		$64 544

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: REGULATORY MEASURES SCENARIO

TABLE 1

SUMMARY - ALL WASTE TYPES

	Tonnes 1987	1989	1992	2000
Total Waste Generated Residential and I.C.I	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted from Landfill and Incineration		483 730	3 298 152	4 972 329
Total Waste Sent to Landfill and Incineration	9 093 384	8 930 470	6 583 508	5 615 585
Reference Quantity	9 093 384	9 414 200	9 829 466	10 686 675
Proportion of Waste Diverted From Landfill and Incineration		5%	33%	47%
Waste Diverted from Landfill and Incineration as a Proportion of Waste Sent to Landfill and Incineration in 1987		5%	34%	47%
Waste Management and Policy Implementation Costs				
	000's of 1989 Dollars			
Cost of Diversions			$313 673	$485 947
Cost of Landfill and Incineration			$557 862	$501 201
Total Waste Management Cost			$871 535	$987 149
Cost of Policies			$31 826	$64 544

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: REGULATORY MEASURES SCENARIO

TABLE 2a Waste Quantities Generated

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP	386 369	400 000	417 644	454 066
Fine Paper	71 478	74 000	77 264	84 002
Boxboard	167 201	173 100	180 736	196 497
OCC	105 286	109 000	113 808	123 733
Mixed Paper	57 279	59 300	61 916	67 315
Magazines	159 474	165 100	172 383	187 416
Telephone Books	12 557	13 000	13 573	14 757
Glass Containers	259 350	268 500	280 344	304 792
Plastic (rigid and film)	132 911	137 600	143 670	156 199
Composite Packaging	11 012	11 400	11 903	12 941
Aluminium Cans, Foil	15 841	16 400	17 123	18 617
Tinplate, Steel Cans	72 541	75 100	78 413	85 251
White Goods	97 945	101 400	105 873	115 106
Used Tires	773	800	835	908
Yard Waste	632 099	654 400	683 266	742 852
Food Waste	603 315	624 600	652 151	709 024
Wood Waste	45 109	46 700	48 760	53 012
Construction/Demolition Waste	11 108	11 500	12 007	13 054
Disposable Diapers	107 217	111 000	115 896	126 003
Foundry Sands				
Asphalt				
Other	966 212	1 000 300	1 044 424	1 135 506
TOTAL	3 915 076	4 053 200	4 231 989	4 601 053
Total Residential Waste Diverted from Solid Waste Management Stream		242 037	1 383 079	2 038 461
Proportion of Residential Waste Diverted from Landfill and Incineration		6%	33%	44%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: REGULATORY MEASURES SCENARIO

TABLE 2b Reduction

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP			32 644	34 066
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books			1 250	1 365
Glass Containers			3 744	5 292
Plastic (rigid and film)			-19 410	-114 951
Composite Packaging				
Aluminium Cans, Foil			5 188	6 332
Tinplate, Steel Cans			-20 687	-13 849
White Goods				
Used Tires				
Yard Waste		2 369	16 800	38 400
Food Waste		7 106	157 880	229 595
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers			36 203	52 488
Foundry Sands				
Asphalt				
Other			62 665	56 775
Total Residential Waste Reduced		9 475	276 277	295 513
Proportion of Residential Waste Stream		0%	7%	6%
Proportion of Total Waste Stream		0%	3%	3%
Waste Diverted through Reduction as a Proportion of Waste Sent to Landfill and Incineration in 1987		0%	3%	3%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: REGULATORY MEASURES SCENARIO

TABLE 2c Reuse

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP				
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books				
Glass Containers				
Plastic (rigid and film)				
Composite Packaging				
Aluminium Cans, Foil				
Tinplate, Steel Cans				
White Goods				
Used Tires				
Yard Waste				
Food Waste				
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Reused				
Proportion of Residential Waste Stream				
Proportion of Total Waste Stream				
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987				

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: REGULATORY MEASURES SCENARIO

TABLE 2d Recycling

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP		155 900	338 799	405 851
Fine Paper			38 552	64 128
Boxboard			60 824	132 746
OCC		830	58 325	97 220
Mixed Paper				
Magazines		260	44 400	90 377
Telephone Books		750	2 800	6 766
Glass Containers		31 000	87 000	140 000
Plastic (rigid and film)		1 030	36 796	145 816
Composite Packaging				
Aluminium Cans, Foil		3 130	4 820	6 600
Tinplate, Steel Cans		16 140	58 000	70 000
White Goods				
Used Tires			84	136
Yard Waste		38 764	439 247	650 807
Food Waste			14 427	50 120
Wood Waste			9 752	15 904
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Sent		247 804	1 193 826	1 876 470
Waste Actually Recycled		232 562	1 106 802	1 742 948
Proportion of Residential Waste Stream		6%	26%	38%
Proportion of Total Waste Stream		2%	11%	16%
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987		3%	12%	19%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: REGULATORY MEASURES SCENARIO

TABLE 3a — Waste Quantities Generated

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP	164 207	170 000	179 154	189 846
Fine Paper	347 732	360 000	379 385	402 028
Boxboard	322 521	333 900	351 879	372 881
OCC	425 972	441 000	464 746	492 484
Mixed Paper	76 694	79 400	83 675	88 669
Magazines	123 252	127 600	134 471	142 496
Telephone Books	7 051	7 300	7 693	8 152
Glass Containers	59 404	61 500	64 812	68 680
Plastic (rigid and film)	98 814	102 300	107 808	114 243
Composite Packaging				
Aluminium Cans, Foil	16 131	16 700	17 599	18 650
Tinplate, Steel Cans	23 762	24 600	25 925	27 472
White Goods				
Used Tires	85 001	88 000	92 738	98 273
Yard Waste	106 251	110 000	115 923	122 842
Food Waste	473 302	490 000	516 385	547 204
Wood Waste	1 390 638	1 439 700	1 517 223	1 607 775
Construction/Demolition Waste	125 184	129 600	136 579	144 730
Disposable Diapers	7 727	8 000	8 431	8 934
Foundry Sands	343 868	356 000	375 169	397 561
Asphalt				
Other	980 797	1 015 400	1 070 076	1 133 941
TOTAL	5 178 308	5 361 000	5 649 671	5 986 861
Total ICI Waste Diverted from Solid Waste Management Stream		241 693	1 857 479	2 582 869
Proportion of ICI Waste Diverted from Landfill and Incineration		5%	33%	43%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: REGULATORY MEASURES SCENARIO

TABLE 3b Reduction

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP			14 154	9 846
Fine Paper			41 318	116 169
Boxboard			3 184	-6 119
OCC			3 846	-8 616
Mixed Paper				-1 451
Magazines			1 401	-2 104
Telephone Books			685	745
Glass Containers			1 412	
Plastic (rigid and film)			-15 552	-88 057
Composite Packaging				
Aluminium Cans, Foil			3 939	4 830
Tinplate, Steel Cans			-14 675	-13 128
White Goods				
Used Tires				-2 227
Yard Waste			1 923	-1 158
Food Waste			4 385	-9 796
Wood Waste			13 923	-26 625
Construction/Demolition Waste			46 079	60 330
Disposable Diapers			2 336	3 257
Foundry Sands			19 169	41 561
Asphalt				
Other			203 314	215 449
Total ICI Waste Reduced			330 841	292 906
Proportion of ICI Waste Stream			6%	5%
Proportion of Total Waste Stream			3%	3%
Waste Diverted through Reduction as a Proportion of Waste Sent to Landfill and Incineration in 1987			4%	3%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: REGULATORY MEASURES SCENARIO

TABLE 3c Reuse

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP				
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books				
Glass Containers				
Plastic (rigid and film)				
Composite Packaging				
Aluminium Cans, Foil				
Tinplate, Steel Cans				
White Goods				
Used Tires				
Yard Waste				
Food Waste				
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total ICI Waste Reused				
Proportion of ICI Waste Stream				
Proportion of Total Waste Stream				
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987				

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: REGULATORY MEASURES SCENARIO

TABLE 3d Recycling

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP		57 000	98 284	130 185
Fine Paper		30 000	146 861	191 961
Boxboard			59 505	114 003
OCC		110 300	330 376	422 161
Mixed Paper			15 700	15 700
Magazines			6 654	14 460
Telephone Books			722	1 300
Glass Containers		16 800	13 400	13 400
Plastic (rigid and film)			31 345	87 213
Composite Packaging				
Aluminium Cans, Foil		5 434	8 278	9 414
Tinplate, Steel Cans		60	16 106	20 229
White Goods				
Used Tires		6 100	26 016	67 812
Yard Waste			30 894	58 389
Food Waste		30 000	197 448	337 143
Wood Waste			650 986	870 417
Construction/Demolition Waste		1 000	42 560	59 440
Disposable Diapers				
Foundry Sands			16 736	120 020
Asphalt				
Other				
Total ICI Waste Sent to Recycling		256 694	1 691 871	2 533 248
Waste Actually Recycled		241 693	1 526 638	2 289 963
Proportion of ICI Waste Stream		5%	27%	38%
Proportion of Total Waste Stream		3%	15%	22%
Waste Diverted through Recycling as a Proportion of Waste Sent to Landfill and Incineration in 1987		3%	17%	25%

Source: Waste Management Policy Model

Selected combination of economic and regulatory measures scenario

Waste Diversion Percentages by Sector and Component

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%		82%	10%	8%		90%	3%
Fine Paper			47%	53%			72%	28%
Boxboard			36%	64%			69%	31%
OCC			57%	43%			88%	12%
Mixed Paper				100%				100%
Magazines			26%	74%			48%	52%
Telephone Books	9%		21%	70%	9%		46%	45%
Glass Containers	1%		58%	40%	2%		70%	29%
Plastic (rigid and film)	-14%		32%	81%	-74%		100%	74%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		53%	17%	34%		54%	12%
Tinplate, Steel Cans	-26%		103%	24%	-16%		102%	14%
White Goods				100%				100%
Used Tires			10%	90%			15%	85%
Yard Waste	2%		74%	23%	5%		92%	3%
Food Waste	34%		2%	64%	45%		7%	48%
Wood Waste			20%	80%			30%	70%
Construction/Demolition Waste				100%				100%
Disposable Diapers	44%			56%	61%			39%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other	11%			89%	9%			91%

	1992					2000				
ICI	Reduction	Reuse	Recycle	Inciner-ation	Landfill	Reduction	Reuse	Recycle	Inciner-ation	Landfill
ONP	8%		52%		41%	5%		62%		33%
Fine Paper	11%		46%		43%	29%		55%		16%
Boxboard	1%		25%		74%	-2%		41%		60%
OCC	1%		71%		28%	-2%		87%		15%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%		5%		94%	-1%		10%		91%
Telephone Books	9%		9%		82%	9%		16%		75%
Glass Containers	2%		39%		58%			41%		59%
Plastic (rigid and film)	-14%		29%		85%	-77%		76%		101%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		49%		28%	26%		56%		18%
Tinplate, Steel Cans	-57%		61%		95%	-48%		73%		75%
White Goods					100%					100%
Used Tires			28%		72%	-2%		69%		33%
Yard Waste	2%		27%		72%	-1%		48%		53%
Food Waste	1%		47%		52%	-2%		76%		26%
Wood Waste	1%		43%		56%	-2%		54%		48%
Construction/Demolition Waste	34%		31%		35%	42%		41%		17%
Disposable Diapers	28%				72%	36%				64%
Foundry Sands	5%		4%		90%	10%		30%		59%
Asphalt					100%					100%
Other	20%				80%	19%				81%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

ECONOMIC AND REGULATORY MEASURES SCENARIO Page 1 of 2

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	402 090	453 067
Reuse				
Recycled		232 562	1 286 632	1 877 590
Landfill	3 915 076	3 811 163	2 543 268	2 270 397
Total Diversion		242 037	1 688 721	2 330 656
Percent Diversion	0%	6%	40%	51%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			337 583	292 906
Reuse				
Recycled		241 693	1 628 888	2 429 929
Incineration				
Landfill	5 178 308	5 119 307	3 683 201	3 264 026
Total Diversion		241 693	1 966 470	2 722 835
Percent Diversion	0%	5%	35%	45%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	3 191 759	4 707 697
Recycled		474 255	2 915 519	4 307 519
Incineration				
Landfill		30 243	276 240	400 178
Total Diversion		474 255	2 915 519	4 307 519
Percent Diversion	0%	94%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	6 226 468	5 534 423
Incineration				
Landfill	9 093 384	8 930 470	6 226 468	5 534 423
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	3 655 192	5 053 491
Percent of Waste Diverted	0%	5%	37%	48%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$484 120	$149 999	$334 121
Incineration			
Landfill	$523 032		$523 032
TOTAL	$1 007 152	$149 999	$857 153

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
EDUCATION PROGRAMS		$14 368	$14 368
VIRGIN MATERIALS TAXES			
LANDFILL BANS			
INDUSTRIAL WASTE AUDITS			
USER CHARGES			
EXPANDED BLUE BOX PROGRAMS		$8 591	$8 591
MANDATORY SOURCE SEPARATION			
YARD AND ORGANIC WASTE COLLECTION PROGRAMS		$4 987	$4 987
TOTAL IMPLEMENTATION COSTS		$27 946	$27 946

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$728 466	$238 583	$489 883
Incineration			
Landfill	$464 899		$464 899
TOTAL	$1 193 366	$238 583	$954 783

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
EDUCATION PROGRAMS		$16 118	$16 118
VIRGIN MATERIALS TAXES			
LANDFILL BANS			
INDUSTRIAL WASTE AUDITS			
USER CHARGES			
EXPANDED BLUE BOX PROGRAMS		$13 837	$13 837
MANDATORY SOURCE SEPARATION			
YARD AND ORGANIC WASTE COLLECTION PROGRAMS		$7 895	$7 895
TOTAL IMPLEMENTATION COSTS		$37 850	$37 850

Source: Waste Management Policy Model

COMPARISON: ECONOMIC AND R vs. CURRENT TREND

	1992	2000	1992	2000
RESIDENTIAL				
Generation	4 231 989	4 601 053	4 231 989	4 601 053
Reduction	402 090	453 067	87 329	90 755
Reuse				
Sent to Recycling	1 286 632	1 877 590	649 802	1 249 966
Landfill	2 543 268	2 270 397	3 494 859	3 260 332
Total Diversion	1 688 721	2 330 656	737 131	1 340 721
Percent Diversion	40%	51%	17%	29%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 649 671	5 986 861	5 649 671	5 986 861
Reduction	337 583	292 906	126 451	75 565
Reuse				
Sent to Recycling	1 628 888	2 429 929	564 750	1 069 924
Incineration				
Landfill	3 683 201	3 264 026	4 958 470	4 841 372
Total Diversion	1 966 470	2 722 835	691 201	1 145 489
Percent Diversion	35%	45%	12%	19%

	1992	2000	1992	2000
RECYCLING				
Received for Recycling	3 191 759	4 707 697	1 328 934	2 538 396
Recycled	2 915 519	4 307 519	1 214 552	2 319 890
Incineration				
Landfill	276 240	400 178	114 382	218 506
Total Diversion	2 915 519	4 307 519	1 214 552	2 319 890
Percent Diversion	91%	91%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	6 226 468	5 534 423	8 453 329	8 101 704
Incineration				
Landfill	6 226 468	5 534 423	8 453 329	8 101 704
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 881 660	10 587 914	9 881 660	10 587 914
Total Waste Diversion	3 655 192	5 053 491	1 428 331	2 486 210
Percent of Waste Diverted	37%	48%	14%	23%

Source: Waste Management Policy Model

COMPARISON: ECONOMIC AND R vs. CURRENT TREND

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	ECONOMIC AND RE	CURRENT TREND	DIFFERENCE
Reduction			
Reuse			
Recycling	$334 121	$133 039	$201 082
Incineration			
Landfill	$523 032	$710 092	-$187 059
TOTAL	$857 153	$843 130	$14 022

INCREMENTAL POLICY IMPLEMENTATION	ECONOMIC AND RE	CURRENT TREND	DIFFERENCE
EDUCATION PROGRAMS vs.	$14 368		$14 368
VIRGIN MATERIALS TAXES vs.			
LANDFILL BANS vs.			
INDUSTRIAL WASTE AUDITS vs.			
USER CHARGES vs.			
EXPANDED BLUE BOX PROGRAMS vs.	$8 591		$8 591
MANDATORY SOURCE SEPARATION vs.			
YARD AND ORGANIC WASTE COLLECTION PRO	$4 987		$4 987
TOTAL IMPLEMENTATION COSTS	$27 946		$27 946

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	ECONOMIC AND RE	CURRENT TREND	DIFFERENCE
Reduction			
Reuse			
Recycling	$489 883	$266 402	$223 481
Incineration			
Landfill	$464 899	$680 555	-$215 655
TOTAL	$954 783	$946 957	$7 826

INCREMENTAL POLICY IMPLEMENTATION	ECONOMIC AND RE	CURRENT TREND	DIFFERENCE
EDUCATION PROGRAMS vs.	$16 118		$16 118
VIRGIN MATERIALS TAXES vs.			
LANDFILL BANS vs.			
INDUSTRIAL WASTE AUDITS vs.			
USER CHARGES vs.			
EXPANDED BLUE BOX PROGRAMS vs.	$13 837		$13 837
MANDATORY SOURCE SEPARATION vs.			
YARD AND ORGANIC WASTE COLLECTION PRO	$7 895		$7 895
TOTAL IMPLEMENTATION COSTS	$37 850		$37 850

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC AND REGULATORY MEASURES SCENARIO

TABLE 1

SUMMARY - ALL WASTE TYPES

	Tonnes 1987	1989	1992	2000
Total Waste Generated Residential and I.C.I	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted from Landfill and Incineration		483 730	3 655 192	5 053 491
Total Waste Sent to Landfill and Incineration	9 093 384	8 930 470	6 226 468	5 534 423
Reference Quantity	9 093 384	9 414 200	9 829 466	10 686 675
Proportion of Waste Diverted From Landfill and Incineration		5%	37%	48%
Waste Diverted from Landfill and Incineration as a Proportion of Waste Sent to Landfill and Incineration in 1987		5%	37%	47%
Waste Management and Policy Implementation Costs	000's of 1989 Dollars			
Cost of Diversions			$334 121	$489 883
Cost of Landfill and Incineration			$523 032	$464 899
Total Waste Management Cost			$857 153	$954 783
Cost of Policies			$27 946	$37 850

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC AND REGULATORY MEASURES SCENARIO

TABLE 2a — Waste Quantities Generated

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP	386 369	400 000	417 644	454 066
Fine Paper	71 478	74 000	77 264	84 002
Boxboard	167 201	173 100	180 736	196 497
OCC	105 286	109 000	113 808	123 733
Mixed Paper	57 279	59 300	61 916	67 315
Magazines	159 474	165 100	172 383	187 416
Telephone Books	12 557	13 000	13 573	14 757
Glass Containers	259 350	268 500	280 344	304 792
Plastic (rigid and film)	132 911	137 600	143 670	156 199
Composite Packaging	11 012	11 400	11 903	12 941
Aluminium Cans, Foil	15 841	16 400	17 123	18 617
Tinplate, Steel Cans	72 541	75 100	78 413	85 251
White Goods	97 945	101 400	105 873	115 106
Used Tires	773	800	835	908
Yard Waste	632 099	654 400	683 266	742 852
Food Waste	603 315	624 600	652 151	709 024
Wood Waste	45 109	46 700	48 760	53 012
Construction/Demolition Waste	11 108	11 500	12 007	13 054
Disposable Diapers	107 217	111 000	115 896	126 003
Foundry Sands				
Asphalt				
Other	966 212	1 000 300	1 044 424	1 135 506
TOTAL	3 915 076	4 053 200	4 231 989	4 601 053
Total Residential Waste Diverted from Solid Waste Management Stream		242 037	1 688 721	2 330 656
Proportion of Residential Waste Diverted from Landfill and Incineration		6%	40%	51%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC AND REGULATORY MEASURES SCENARIO

TABLE 2b Reduction

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP			32 644	34 066
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books			1 250	1 365
Glass Containers			3 744	5 292
Plastic (rigid and film)			-19 410	-114 951
Composite Packaging				
Aluminium Cans, Foil			5 188	6 332
Tinplate, Steel Cans			-20 687	-13 849
White Goods				
Used Tires				
Yard Waste		2 369	16 800	38 400
Food Waste		7 106	220 260	319 737
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers			50 548	76 750
Foundry Sands				
Asphalt				
Other			111 753	99 925
Total Residential Waste Reduced		9 475	402 090	453 067
Proportion of Residential Waste Stream		0%	10%	10%
Proportion of Total Waste Stream		0%	4%	4%
Waste Diverted through Reduction as a Proportion of Waste Sent to Landfill and Incineration in 1987		0%	4%	5%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC AND REGULATORY MEASURES SCENARIO

TABLE 2c Reuse

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP				
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books				
Glass Containers				
Plastic (rigid and film)				
Composite Packaging				
Aluminium Cans, Foil				
Tinplate, Steel Cans				
White Goods				
Used Tires				
Yard Waste				
Food Waste				
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Reused				
Proportion of Residential Waste Stream				
Proportion of Total Waste Stream				
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987				

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC AND REGULATORY MEASURES SCENARIO

TABLE 2d Recycling

RESIDENTIAL Tonnes	1987	1989	1992	2000
ONP		155 900	343 130	406 895
Fine Paper			36 402	60 402
Boxboard			65 620	135 296
OCC		830	65 032	108 494
Mixed Paper				
Magazines		260	44 400	90 377
Telephone Books		750	2 800	6 766
Glass Containers		31 000	163 631	212 271
Plastic (rigid and film)		1 030	46 515	156 092
Composite Packaging				
Aluminium Cans, Foil		3 130	9 102	9 967
Tinplate, Steel Cans		16 140	80 494	87 061
White Goods				
Used Tires			84	136
Yard Waste		38 764	507 413	681 919
Food Waste			14 427	50 120
Wood Waste			9 752	15 904
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total Residential Waste Sent		247 804	1 388 802	2 021 699
Waste Actually Recycled		232 562	1 286 632	1 877 590
Proportion of Residential Waste Stream		6%	30%	41%
Proportion of Total Waste Stream		2%	13%	18%
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987		3%	14%	21%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC AND REGULATORY MEASURES SCENARIO

TABLE 3a — Waste Quantities Generated

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP	164 207	170 000	179 154	189 846
Fine Paper	347 732	360 000	379 385	402 028
Boxboard	322 521	333 900	351 879	372 881
OCC	425 972	441 000	464 746	492 484
Mixed Paper	76 694	79 400	83 675	88 669
Magazines	123 252	127 600	134 471	142 496
Telephone Books	7 051	7 300	7 693	8 152
Glass Containers	59 404	61 500	64 812	68 680
Plastic (rigid and film)	98 814	102 300	107 808	114 243
Composite Packaging				
Aluminium Cans, Foil	16 131	16 700	17 599	18 650
Tinplate, Steel Cans	23 762	24 600	25 925	27 472
White Goods				
Used Tires	85 001	88 000	92 738	98 273
Yard Waste	106 251	110 000	115 923	122 842
Food Waste	473 302	490 000	516 385	547 204
Wood Waste	1 390 638	1 439 700	1 517 223	1 607 775
Construction/Demolition Waste	125 184	129 600	136 579	144 730
Disposable Diapers	7 727	8 000	8 431	8 934
Foundry Sands	343 868	356 000	375 169	397 561
Asphalt				
Other	980 797	1 015 400	1 070 076	1 133 941
TOTAL	5 178 308	5 361 000	5 649 671	5 986 861
Total ICI Waste Diverted from Solid Waste Management Stream		241 693	1 966 470	2 722 835
Proportion of ICI Waste Diverted from Landfill and Incineration		5%	35%	45%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC AND REGULATORY MEASURES SCENARIO

TABLE 3b Reduction

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP			14 154	9 846
Fine Paper			41 318	116 169
Boxboard			3 184	-6 119
OCC			3 846	-8 616
Mixed Paper				-1 451
Magazines			1 401	-2 104
Telephone Books			685	745
Glass Containers			1 412	
Plastic (rigid and film)			-15 552	-88 057
Composite Packaging				
Aluminium Cans, Foil			3 939	4 830
Tinplate, Steel Cans			-14 675	-13 128
White Goods				
Used Tires				-2 227
Yard Waste			1 923	-1 158
Food Waste			4 385	-9 796
Wood Waste			13 923	-26 625
Construction/Demolition Waste			46 079	60 330
Disposable Diapers			2 336	3 257
Foundry Sands			19 169	41 561
Asphalt				
Other			210 056	215 449
Total ICI Waste Reduced			337 583	292 906
Proportion of ICI Waste Stream			6%	5%
Proportion of Total Waste Stream			3%	3%
Waste Diverted through Reduction as a Proportion of Waste Sent to Landfill and Incineration in 1987			4%	3%

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC AND REGULATORY MEASURES SCENARIO

TABLE 3c Reuse

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP				
Fine Paper				
Boxboard				
OCC				
Mixed Paper				
Magazines				
Telephone Books				
Glass Containers				
Plastic (rigid and film)				
Composite Packaging				
Aluminium Cans, Foil				
Tinplate, Steel Cans				
White Goods				
Used Tires				
Yard Waste				
Food Waste				
Wood Waste				
Construction/Demolition Waste				
Disposable Diapers				
Foundry Sands				
Asphalt				
Other				
Total ICI Waste Reused				
Proportion of ICI Waste Stream				
Proportion of Total Waste Stream				
Waste Diverted through Reuse as a Proportion of Waste Sent to Landfill and Incineration in 1987				

Source: Waste Management Policy Model

ANALYSIS OF WASTE FLOWS IN ONTARIO

WASTE DIVERSION THROUGH - REDUCTION, RE-USE AND RECYCLING

BY COMPONENT

SCENARIO: ECONOMIC AND REGULATORY MEASURES SCENARIO

TABLE 3d Recycling

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL Tonnes	1987	1989	1992	2000
ONP		57 000	92 354	117 731
Fine Paper		30 000	175 542	220 131
Boxboard			88 424	153 753
OCC		110 300	330 376	427 095
Mixed Paper			15 700	15 700
Magazines			6 654	14 460
Telephone Books			722	1 300
Glass Containers		16 800	25 515	28 054
Plastic (rigid and film)			31 345	87 213
Composite Packaging				
Aluminium Cans, Foil		5 434	8 655	10 383
Tinplate, Steel Cans		60	15 848	20 008
White Goods				
Used Tires		6 100	26 016	67 812
Yard Waste			30 894	58 389
Food Waste		30 000	244 631	414 093
Wood Waste			650 986	870 417
Construction/Demolition Waste		1 000	42 560	59 440
Disposable Diapers				
Foundry Sands			16 736	120 020
Asphalt				
Other				
Total ICI Waste Sent to Recycling		256 694	1 802 957	2 685 998
Waste Actually Recycled		241 693	1 628 888	2 429 929
Proportion of ICI Waste Stream		5%	29%	41%
Proportion of Total Waste Stream		3%	16%	23%
Waste Diverted through Recycling as a Proportion of Waste Sent to Landfill and Incineration in 1987		3%	18%	27%

Source: Waste Management Policy Model

Individual measures

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		74%	18%	8%		86%	7%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			1%	99%			2%	98%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%	10%	31%	57%	2%	12%	46%	41%
Plastic (rigid and film)	-14%		7%	106%	-74%		43%	130%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		43%	27%	34%		44%	22%
Tinplate, Steel Cans	-26%		79%	47%	-16%		86%	31%
White Goods				100%				100%
Used Tires			7%	94%			8%	92%
Yard Waste	2%		21%	77%	5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		32%		60%	5%		30%		65%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%				99%	-2%				102%
OCC	1%		30%		69%	-2%		51%		51%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%	12%	21%		66%		18%	20%		62%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			21%		79%	-2%		66%		37%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	87 329	90 755
Reuse			28 440	35 888
Recycled		232 562	658 320	1 258 144
Landfill	3 915 076	3 811 163	3 457 900	3 216 267
Total Diversion		242 037	774 089	1 384 786
Percent Diversion	0%	6%	18%	30%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			126 451	75 565
Reuse			7 500	12 438
Recycled		241 693	569 416	1 072 802
Incineration				
Landfill	5 178 308	5 119 307	4 946 304	4 826 056
Total Diversion		241 693	703 367	1 160 805
Percent Diversion	0%	5%	12%	19%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 342 776	2 549 882
Recycled		474 255	1 227 737	2 330 946
Incineration				
Landfill		30 243	115 039	218 937
Total Diversion		474 255	1 227 737	2 330 946
Percent Diversion	0%	94%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 404 203	8 042 323
Incineration				
Landfill	9 093 384	8 930 470	8 404 203	8 042 323
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 477 457	2 545 591
Percent of Waste Diverted	0%	5%	15%	24%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse	$7 199	$5 939	$1 260
Recycling	$207 936	$77 340	$130 596
Incineration			
Landfill	$705 965		$705 965
TOTAL	$921 100	$83 279	$837 821

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
DEPOSIT SYSTEMS			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse	$9 680	$7 986	$1 694
Recycling	$396 258	$131 554	$264 704
Incineration			
Landfill	$675 567		$675 567
TOTAL	$1 081 505	$139 540	$941 965

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
DEPOSIT SYSTEMS			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%		75%	17%	8%		86%	6%
Fine Paper			29%	71%			54%	46%
Boxboard			22%	78%			54%	46%
OCC			6%	94%			10%	90%
Mixed Paper				100%				100%
Magazines			14%	86%			33%	67%
Telephone Books	9%		13%	78%	9%		37%	53%
Glass Containers	1%		34%	64%	2%		49%	50%
Plastic (rigid and film)	-14%		15%	99%	-74%		60%	113%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		31%	39%	34%		38%	28%
Tinplate, Steel Cans	-26%		78%	49%	-16%		85%	31%
White Goods				100%				100%
Used Tires		2%		98%		2%		98%
Yard Waste	7%		21%	72%	7%		57%	35%
Food Waste	12%		2%	86%	21%		7%	72%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	22%			78%	22%			78%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other	6%			94%	4%			96%

	1992					2000				
ICI	Reduction	Reuse	Recycle	Incineration	Landfill	Reduction	Reuse	Recycle	Incineration	Landfill
ONP	8%		33%		59%	5%		33%		62%
Fine Paper	11%		16%		73%	29%		25%		46%
Boxboard	1%		3%		96%	-2%		5%		97%
OCC	1%		37%		62%	-2%		51%		50%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%		2%		89%	9%		3%		88%
Glass Containers	2%		23%		75%			24%		76%
Plastic (rigid and film)	-14%		17%		98%	-77%		48%		129%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		37%		40%	26%		37%		37%
Tinplate, Steel Cans	-57%		40%		116%	-48%		47%		101%
White Goods					100%					100%
Used Tires		2%	18%		80%	-2%	1%	64%		38%
Yard Waste	4%				96%	2%				98%
Food Waste	4%		18%		77%	3%		29%		68%
Wood Waste	1%		16%		83%	-2%		23%		79%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	19%				81%	19%				81%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other	6%				94%	4%				96%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	218 662	194 130
Reuse			17	18
Recycled		232 562	701 194	1 320 958
Landfill	3 915 076	3 811 163	3 312 117	3 085 947
Total Diversion		242 037	919 872	1 515 106
Percent Diversion	0%	6%	22%	33%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			209 956	148 779
Reuse			1 561	781
Recycled		241 693	678 600	1 164 274
Incineration				
Landfill	5 178 308	5 119 307	4 759 554	4 673 028
Total Diversion		241 693	890 117	1 313 833
Percent Diversion	0%	5%	16%	22%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 506 794	2 714 568
Recycled		474 255	1 379 794	2 485 232
Incineration				
Landfill		30 243	127 000	229 336
Total Diversion		474 255	1 379 794	2 485 232
Percent Diversion	0%	94%	92%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 071 671	7 758 974
Incineration				
Landfill	9 093 384	8 930 470	8 071 671	7 758 974
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 809 989	2 828 940
Percent of Waste Diverted	0%	5%	18%	27%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$234 658	$87 352	$147 307
Incineration			
Landfill	$678 032		$678 032
TOTAL	$912 690	$87 352	$825 338
INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
EDUCATION PROGRAMS		$14 368	$14 368
TOTAL IMPLEMENTATION COSTS		$14 368	$14 368

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$426 518	$149 895	$276 623
Incineration			
Landfill	$651 765		$651 765
TOTAL	$1 078 283	$149 895	$928 388
INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
EDUCATION PROGRAMS		$16 118	$16 118
TOTAL IMPLEMENTATION COSTS		$16 118	$16 118

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		75%	17%	8%		87%	6%
Fine Paper			36%	64%			63%	37%
Boxboard			28%	72%			59%	41%
OCC			10%	90%			30%	70%
Mixed Paper				100%				100%
Magazines			15%	85%			37%	63%
Telephone Books	9%		17%	74%	9%		43%	48%
Glass Containers	1%		39%	60%	2%		53%	46%
Plastic (rigid and film)	-14%		11%	103%	-74%		61%	113%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		33%	37%	34%		41%	25%
Tinplate, Steel Cans	-26%		83%	44%	-16%		89%	28%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		21%	77%	5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		32%		60%	5%		30%		65%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%				99%	-2%				102%
OCC	1%		30%		69%	-2%		51%		51%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		21%		77%			20%		80%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	87 329	90 755
Reuse				
Recycled		232 562	733 245	1 384 354
Landfill	3 915 076	3 811 163	3 411 415	3 125 945
Total Diversion		242 037	820 574	1 475 108
Percent Diversion	0%	6%	19%	32%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			126 451	75 565
Reuse				
Recycled		241 693	564 750	1 069 924
Incineration				
Landfill	5 178 308	5 119 307	4 958 470	4 841 372
Total Diversion		241 693	691 201	1 145 489
Percent Diversion	0%	5%	12%	19%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 417 907	2 679 912
Recycled		474 255	1 297 995	2 454 278
Incineration				
Landfill		30 243	119 912	225 634
Total Diversion		474 255	1 297 995	2 454 278
Percent Diversion	0%	94%	92%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 369 885	7 967 317
Incineration				
Landfill	9 093 384	8 930 470	8 369 885	7 967 317
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 511 775	2 620 597
Percent of Waste Diverted	0%	5%	15%	25%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$219 947	$80 760	$139 186
Incineration			
Landfill	$703 082		$703 082
TOTAL	$923 029	$80 760	$842 269

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
EXPANDED BLUE BOX PROGRAMS		$8 591	$8 591
TOTAL IMPLEMENTATION COSTS		$8 591	$8 591

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$420 196	$146 252	$273 943
Incineration			
Landfill	$669 266		$669 266
TOTAL	$1 089 462	$146 252	$943 209

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
EXPANDED BLUE BOX PROGRAMS		$13 837	$13 837
TOTAL IMPLEMENTATION COSTS		$13 837	$13 837

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		76%	16%	8%		87%	5%
Fine Paper			34%	66%			59%	41%
Boxboard			28%	72%			56%	44%
OCC			21%	79%			32%	68%
Mixed Paper				100%				100%
Magazines			16%	84%			37%	63%
Telephone Books	9%		13%	78%	9%		40%	51%
Glass Containers	1%		38%	60%	2%		52%	46%
Plastic (rigid and film)	-14%		10%	104%	-74%		54%	120%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		33%	37%	34%		41%	25%
Tinplate, Steel Cans	-26%		78%	49%	-16%		87%	29%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	22%		21%	57%	26%		57%	17%
Food Waste	11%		2%	87%	22%		7%	71%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other	5%			95%	5%			95%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		38%		54%	5%		43%		52%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%				99%	-2%				102%
OCC	1%		44%		56%	-2%		64%		38%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%		2%		89%	9%		5%		86%
Glass Containers	2%		25%		73%			26%		74%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		39%		38%	26%		42%		32%
Tinplate, Steel Cans	-57%		43%		114%	-48%		52%		95%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	11%				89%	19%				81%
Food Waste	5%		18%		77%	5%		29%		65%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other	5%				95%	5%				95%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992			2000		
Solid Waste Management	Recycle	Inciner-ation	Landfill	Recycle	Inciner-ation	Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

	1992			2000		
Recycling	Recycle	Inciner-ation	Landfill	Recycle	Inciner-ation	Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	291 030	339 260
Reuse				
Recycled		232 562	740 642	1 366 273
Landfill	3 915 076	3 811 163	3 200 316	2 895 519
Total Diversion		242 037	1 031 673	1 705 534
Percent Diversion	0%	6%	24%	37%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			212 182	196 785
Reuse				
Recycled		241 693	640 731	1 161 172
Incineration				
Landfill	5 178 308	5 119 307	4 796 758	4 628 904
Total Diversion		241 693	852 913	1 357 957
Percent Diversion	0%	5%	15%	23%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 505 785	2 757 414
Recycled		474 255	1 381 374	2 527 445
Incineration				
Landfill		30 243	124 411	229 969
Total Diversion		474 255	1 381 374	2 527 445
Percent Diversion	0%	94%	92%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	7 997 074	7 524 423
Incineration				
Landfill	9 093 384	8 930 470	7 997 074	7 524 423
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 884 586	3 063 491
Percent of Waste Diverted	0%	5%	19%	29%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$233 552	$86 038	$147 514
Incineration			
Landfill	$671 766		$671 766
TOTAL	$905 317	$86 038	$819 280
INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
INCREASE MUNICIPAL FUNDING	--	$35 362	$35 362
TOTAL IMPLEMENTATION COSTS		$35 362	$35 362

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$431 071	$149 420	$281 651
Incineration			
Landfill	$632 062		$632 062
TOTAL	$1 063 133	$149 420	$913 713
INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
INCREASE MUNICIPAL FUNDING		$44 742	$44 742
TOTAL IMPLEMENTATION COSTS		$44 742	$44 742

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%		74%	18%	8%		86%	7%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			1%	99%			2%	98%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-14%		6%	107%	-74%		41%	133%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		21%	77%	5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

	1992					2000				
ICI	Reduction	Reuse	Recycle	Inciner-ation	Landfill	Reduction	Reuse	Recycle	Inciner-ation	Landfill
ONP	8%		41%		51%	5%		46%		49%
Fine Paper	11%		24%		65%	29%		33%		38%
Boxboard	1%		10%		89%	-2%		20%		81%
OCC	1%		44%		56%	-2%		66%		36%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%		5%		94%	-1%		10%		91%
Telephone Books	16%				84%	23%				77%
Glass Containers	2%		25%		73%			24%		76%
Plastic (rigid and film)	-9%		13%		96%	-66%		50%		116%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		39%		38%	26%		40%		34%
Tinplate, Steel Cans	-57%		43%		114%	-48%		50%		98%
White Goods					100%					100%
Used Tires			20%		80%	-2%		64%		38%
Yard Waste	11%				89%	16%				84%
Food Waste	9%		18%		73%	13%		29%		58%
Wood Waste	1%		21%		78%	-2%		32%		70%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other	10%				90%	10%				90%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Incineration	1992 Landfill	2000 Recycle	2000 Incineration	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Incineration	1992 Landfill	2000 Recycle	2000 Incineration	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	87 329	90 755
Reuse				
Recycled		232 562	649 802	1 249 966
Landfill	3 915 076	3 811 163	3 494 859	3 260 332
Total Diversion		242 037	737 131	1 340 721
Percent Diversion	0%	6%	17%	29%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			292 662	303 124
Reuse				
Recycled		241 693	847 790	1 482 306
Incineration				
Landfill	5 178 308	5 119 307	4 509 219	4 201 431
Total Diversion		241 693	1 140 452	1 785 430
Percent Diversion	0%	5%	20%	30%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 637 475	2 987 806
Recycled		474 255	1 497 592	2 732 272
Incineration				
Landfill		30 243	139 883	255 534
Total Diversion		474 255	1 497 592	2 732 272
Percent Diversion	0%	94%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 004 077	7 461 763
Incineration				
Landfill	9 093 384	8 930 470	8 004 077	7 461 763
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 877 583	3 126 151
Percent of Waste Diverted	0%	5%	19%	30%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$252 336	$89 215	$163 121
Incineration			
Landfill	$672 354		$672 354
TOTAL	$924 690	$89 215	$835 475
INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
INDUSTRIAL WASTE AUDITS			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$463 307	$152 913	$310 394
Incineration			
Landfill	$626 799		$626 799
TOTAL	$1 090 105	$152 913	$937 193
INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
INDUSTRIAL WASTE AUDITS			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		78%	14%	8%		87%	5%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			31%	69%			51%	49%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-14%		6%	107%	-74%		41%	133%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires			10%	90%			15%	85%
Yard Waste	29%		21%	50%	20%		57%	23%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste			20%	80%			30%	70%
Construction/Demolition Waste				100%				100%
Disposable Diapers	26%			74%	34%			66%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other	5%			95%	5%			95%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		41%		51%	5%		46%		49%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%				99%	-2%				102%
OCC	1%		51%		49%	-2%		64%		38%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		21%		77%			20%		80%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			24%		76%	-2%		67%		35%
Yard Waste	11%				89%	14%				86%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		30%		69%	-2%		37%		65%
Construction/Demolition Waste	34%		31%		35%	42%		41%		17%
Disposable Diapers	28%				72%	36%				64%
Foundry Sands	5%		4%		90%	10%		30%		59%
Asphalt					100%					100%
Other	10%				90%	10%				90%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	335 648	282 854
Reuse				
Recycled		232 562	707 422	1 328 370
Landfill	3 915 076	3 811 163	3 188 919	2 989 829
Total Diversion		242 037	1 043 070	1 611 224
Percent Diversion	0%	6%	25%	35%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			245 934	209 451
Reuse				
Recycled		241 693	927 142	1 406 819
Incineration				
Landfill	5 178 308	5 119 307	4 476 595	4 370 590
Total Diversion		241 693	1 173 076	1 616 271
Percent Diversion	0%	5%	21%	27%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 796 748	3 000 134
Recycled		474 255	1 634 564	2 735 189
Incineration				
Landfill		30 243	162 184	264 945
Total Diversion		474 255	1 634 564	2 735 189
Percent Diversion	0%	94%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	7 665 513	7 360 420
Incineration				
Landfill	9 093 384	8 930 470	7 665 513	7 360 420
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	2 216 147	3 227 494
Percent of Waste Diverted	0%	5%	22%	30%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$270 329	$83 232	$187 098
Incineration			
Landfill	$643 914		$643 914
TOTAL	$914 243	$83 232	$831 012

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
LANDFILL BANS			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$458 006	$138 332	$319 674
Incineration			
Landfill	$618 286		$618 286
TOTAL	$1 076 292	$138 332	$937 960

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
LANDFILL BANS			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		74%	18%	8%		86%	7%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			1%	99%			2%	98%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-14%		6%	107%	-74%		41%	133%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		21%	77%	5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		35%		57%	5%		37%		58%
Fine Paper	11%		20%		69%	29%		30%		41%
Boxboard	1%				99%	-2%				102%
OCC	1%		44%		56%	-2%		64%		38%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%		5%		87%	9%		6%		85%
Glass Containers	2%		25%		73%			26%		74%
Plastic (rigid and film)	-14%		15%		99%	-77%		57%		120%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		40%		38%	26%		40%		34%
Tinplate, Steel Cans	-57%		40%		116%	-48%		47%		101%
White Goods					100%					100%
Used Tires		2%	18%		80%	-2%	1%	64%		37%
Yard Waste	2%				98%	-1%				101%
Food Waste	5%		18%		77%	8%		29%		62%
Wood Waste	1%		21%		78%	-2%		33%		69%
Construction/Demolition Waste	34%		27%		40%	42%		38%		20%
Disposable Diapers	23%				77%	27%				73%
Foundry Sands	7%		1%		92%	15%		27%		58%
Asphalt					100%					100%
Other	5%				95%	5%				95%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992			2000		
Solid Waste Management	Recycle	Inciner-ation	Landfill	Recycle	Inciner-ation	Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

	1992			2000		
Recycling	Recycle	Inciner-ation	Landfill	Recycle	Inciner-ation	Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	87 329	90 755
Reuse				
Recycled		232 562	649 802	1 249 966
Landfill	3 915 076	3 811 163	3 494 859	3 260 332
Total Diversion		242 037	737 131	1 340 721
Percent Diversion	0%	6%	17%	29%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			208 567	206 322
Reuse			1 561	1 173
Recycled		241 693	787 033	1 381 397
Incineration				
Landfill	5 178 308	5 119 307	4 652 510	4 397 969
Total Diversion		241 693	997 161	1 588 892
Percent Diversion	0%	5%	18%	27%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 573 491	2 880 718
Recycled		474 255	1 436 835	2 631 363
Incineration				
Landfill		30 243	136 656	249 355
Total Diversion		474 255	1 436 835	2 631 363
Percent Diversion	0%	94%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 147 368	7 658 301
Incineration				
Landfill	9 093 384	8 930 470	8 147 368	7 658 301
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 734 292	2 929 613
Percent of Waste Diverted	0%	5%	18%	28%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$241 730	$85 193	$156.538
Incineration			
Landfill	$684 391		$684 391
TOTAL	$926 121	$85 193	$840 928

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
LANDFILL TIPPING FEES			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$446 577	$148 901	$297 675
Incineration			
Landfill	$643 308		$643 308
TOTAL	$1 089 885	$148 901	$940 983

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
LANDFILL TIPPING FEES			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		74%	18%	8%		86%	7%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			1%	99%			2%	98%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		30%	68%	2%		44%	55%
Plastic (rigid and film)	-14%		6%	107%	-74%		41%	133%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		27%	42%	34%		33%	33%
Tinplate, Steel Cans	-26%		72%	55%	-16%		76%	40%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		21%	77%	5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		32%		60%	5%		30%		65%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%				99%	-2%				102%
OCC	1%		30%		69%	-2%		51%		51%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		20%		78%			18%		82%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992			2000		
Solid Waste Management	Recycle	Inciner-ation	Landfill	Recycle	Inciner-ation	Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard	7%		93%	40%		60%
OCC			100%			100%
Mixed Paper	7%		93%	40%		60%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers	5%		95%	33%		67%
Plastic (rigid and film)	3%		97%	22%		78%
Composite Packaging			100%			100%
Aluminium Cans, Foil	5%		95%	75%		25%
Tinplate, Steel Cans	5%		95%	75%		25%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

	1992			2000		
Recycling	Recycle	Inciner-ation	Landfill	Recycle	Inciner-ation	Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	87 329	90 755
Reuse				
Recycled		232 562	646 421	1 238 458
Landfill	3 915 076	3 811 163	3 498 240	3 271 840
Total Diversion		242 037	733 750	1 329 213
Percent Diversion	0%	6%	17%	29%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			126 451	75 565
Reuse				
Recycled		241 693	564 380	1 069 060
Incineration				
Landfill	5 178 308	5 119 307	4 958 840	4 842 236
Total Diversion		241 693	690 831	1 144 625
Percent Diversion	0%	5%	12%	19%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 393 857	2 994 182
Recycled		474 255	1 275 375	2 749 569
Incineration				
Landfill		30 243	118 483	244 613
Total Diversion		474 255	1 275 375	2 749 569
Percent Diversion	0%	94%	91%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 457 080	8 114 076
Incineration				
Landfill	9 093 384	8 930 470	8 392 506	7 672 026
Sent to Recycling			64 574	442 050
Percent Diversion	0%	0%	1%	5%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 489 154	2 915 888
Percent of Waste Diverted	0%	5%	15%	28%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$215 943	$77 697	$138 246
Incineration			
Landfill	$710 407		$710 407
TOTAL	$926 350	$77 697	$848 653

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
MANDATORY PROCESSING OF SOLID WASTE	$658	$3 222	$3 880
TOTAL IMPLEMENTATION COSTS	$658	$3 222	$3 880

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$476 270	$186 701	$289 569
Incineration			
Landfill	$681 594		$681 594
TOTAL	$1 157 864	$186 701	$971 163

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
MANDATORY PROCESSING OF SOLID WASTE	$4 529	$22 165	$26 694
TOTAL IMPLEMENTATION COSTS	$4 529	$22 165	$26 694

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		76%	16%	8%		87%	5%
Fine Paper			31%	69%			58%	42%
Boxboard			24%	76%			57%	43%
OCC			16%	84%			32%	68%
Mixed Paper				100%				100%
Magazines			15%	85%			37%	63%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		39%	60%	2%		55%	43%
Plastic (rigid and film)	-14%		14%	100%	-74%		64%	110%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		36%	33%	34%		42%	24%
Tinplate, Steel Cans	-26%		82%	45%	-16%		87%	29%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	11%		21%	68%	13%		57%	30%
Food Waste	20%		2%	77%	29%		7%	64%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	21%			79%	25%			75%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		35%		57%	5%		37%		58%
Fine Paper	11%		20%		69%	29%		28%		43%
Boxboard	1%		5%		94%	-2%		8%		94%
OCC	1%		40%		59%	-2%		64%		38%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		24%		74%			26%		74%
Plastic (rigid and film)	-14%		17%		98%	-77%		51%		126%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		39%		38%	26%		40%		34%
Tinplate, Steel Cans	-57%		49%		108%	-48%		56%		92%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	5%		18%		77%	4%		29%		67%
Wood Waste	1%		21%		78%	-2%		33%		69%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	234 056	246 480
Reuse				
Recycled		232 562	734 844	1 388 512
Landfill	3 915 076	3 811 163	3 263 090	2 966 061
Total Diversion		242 037	968 900	1 634 992
Percent Diversion	0%	6%	23%	36%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			147 279	107 344
Reuse				
Recycled		241 693	787 449	1 391 936
Incineration				
Landfill	5 178 308	5 119 307	4 714 944	4 487 582
Total Diversion		241 693	934 727	1 499 279
Percent Diversion	0%	5%	17%	25%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 663 202	3 037 611
Recycled		474 255	1 522 293	2 780 448
Incineration				
Landfill		30 243	140 909	257 163
Total Diversion		474 255	1 522 293	2 780 448
Percent Diversion	0%	94%	92%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	7 978 033	7 453 643
Incineration				
Landfill	9 093 384	8 930 470	7 978 033	7 453 643
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 903 627	3 134 271
Percent of Waste Diverted	0%	5%	19%	30%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$257 657	$96 259	$161 398
Incineration			
Landfill	$670 166		$670 166
TOTAL	$927 823	$96 259	$831 564

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
MANDATORY SOURCE SEPARATION			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$474 593	$166 578	$308 016
Incineration			
Landfill	$626 117		$626 117
TOTAL	$1 100 710	$166 578	$934 132

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
MANDATORY SOURCE SEPARATION			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		74%	18%	8%		86%	7%
Fine Paper			25%	75%			50%	50%
Boxboard	4%		20%	76%	4%		50%	46%
OCC	5%		1%	94%	7%		2%	91%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-5%		6%	99%	-57%		41%	116%
Composite Packaging	8%		5%	87%	15%		7%	78%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		21%	77%	5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		32%		60%	5%		30%		65%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	4%				96%	3%				97%
OCC	3%		40%		57%	1%		60%		40%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		21%		77%			20%		80%
Plastic (rigid and film)	-9%		11%		98%	-69%		40%		129%
Composite Packaging	8%		5%		87%	15%		7%		78%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	112 874	135 110
Reuse				
Recycled		232 562	650 349	1 250 800
Landfill	3 915 076	3 811 163	3 468 765	3 215 143
Total Diversion		242 037	763 224	1 385 910
Percent Diversion	0%	6%	18%	30%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			152 289	115 815
Reuse				
Recycled		241 693	610 720	1 110 396
Incineration				
Landfill	5 178 308	5 119 307	4 886 662	4 760 651
Total Diversion		241 693	763 009	1 226 210
Percent Diversion	0%	5%	14%	20%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 377 919	2 581 904
Recycled		474 255	1 261 070	2 361 195
Incineration				
Landfill		30 243	116 849	220 709
Total Diversion		474 255	1 261 070	2 361 195
Percent Diversion	0%	94%	92%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 355 428	7 975 794
Incineration				
Landfill	9 093 384	8 930 470	8 355 428	7 975 794
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 526 233	2 612 120
Percent of Waste Diverted	0%	5%	15%	25%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$212 456	$74 693	$137 763
Incineration			
Landfill	$701 868		$701 868
TOTAL	$914 323	$74 693	$839 630
INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
PACKAGING TAXES			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$400 387	$129 715	$270 672
Incineration			
Landfill	$669 978		$669 978
TOTAL	$1 070 365	$129 715	$940 650
INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
PACKAGING TAXES			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		74%	18%	8%		86%	7%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			1%	99%			2%	98%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-11%		6%	105%	-67%		41%	126%
Composite Packaging	10%			90%	25%			75%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		21%	77%	5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	38%			62%	50%			50%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		32%		60%	5%		30%		65%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%				99%	-2%				102%
OCC	1%		30%		69%	-2%		51%		51%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		21%		77%			20%		80%
Plastic (rigid and film)	-12%		11%		101%	-70%		40%		130%
Composite Packaging	10%				90%	25%				75%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	28%				72%	34%				66%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	119 201	148 876
Reuse				
Recycled		232 562	649 802	1 249 966
Landfill	3 915 076	3 811 163	3 462 987	3 202 211
Total Diversion		242 037	769 003	1 398 842
Percent Diversion	0%	6%	18%	30%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			130 291	86 106
Reuse				
Recycled		241 693	564 750	1 069 924
Incineration				
Landfill	5 178 308	5 119 307	4 954 630	4 830 831
Total Diversion		241 693	695 041	1 156 030
Percent Diversion	0%	5%	12%	19%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 328 934	2 538 396
Recycled		474 255	1 214 552	2 319 890
Incineration				
Landfill		30 243	114 382	218 506
Total Diversion		474 255	1 214 552	2 319 890
Percent Diversion	0%	94%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 417 616	8 033 042
Incineration				
Landfill	9 093 384	8 930 470	8 417 616	8 033 042
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 464 044	2 554 872
Percent of Waste Diverted	0%	5%	15%	24%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$204 745	$71 706	$133 039
Incineration			
Landfill	$707 092		$707 092
TOTAL	$911 836	$71 706	$840 130

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
PRODUCT BANS			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$393 487	$127 085	$266 402
Incineration			
Landfill	$674 787		$674 787
TOTAL	$1 068 274	$127 085	$941 189

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
PRODUCT BANS			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	9%		74%	18%	8%		86%	6%
Fine Paper			25%	75%			50%	50%
Boxboard	4%		20%	76%	4%		50%	47%
OCC			1%	99%			2%	98%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	13%		9%	78%	14%		34%	52%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-8%		6%	102%	-66%		41%	125%
Composite Packaging	7%			93%	12%			88%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		21%	77%	5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

	1992					2000				
ICI	Reduction	Reuse	Recycle	Incineration	Landfill	Reduction	Reuse	Recycle	Incineration	Landfill
ONP	9%		32%		59%	8%		30%		62%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	8%				92%	11%				89%
OCC	1%		30%		69%	-2%		51%		51%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	16%				84%	23%				77%
Glass Containers	2%		21%		77%			20%		80%
Plastic (rigid and film)	-10%		11%		100%	-70%		40%		130%
Composite Packaging	7%				93%	12%				88%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	106 292	114 557
Reuse				
Recycled		232 562	649 802	1 249 966
Landfill	3 915 076	3 811 163	3 475 895	3 236 530
Total Diversion		242 037	756 094	1 364 523
Percent Diversion	0%	6%	18%	30%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			157 938	136 606
Reuse				
Recycled		241 693	564 750	1 069 924
Incineration				
Landfill	5 178 308	5 119 307	4 926 983	4 780 331
Total Diversion		241 693	722 688	1 206 530
Percent Diversion	0%	5%	13%	20%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 328 934	2 538 396
Recycled		474 255	1 214 552	2 319 890
Incineration				
Landfill		30 243	114 382	218 506
Total Diversion		474 255	1 214 552	2 319 890
Percent Diversion	0%	94%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 402 878	8 016 861
Incineration				
Landfill	9 093 384	8 930 470	8 402 878	8 016 861
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 478 782	2 571 053
Percent of Waste Diverted	0%	5%	15%	24%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
1992 COSTS OF WASTE MANAGEMENT	**Costs**	**Revenues**	**Net**
Reduction			
Reuse			
Recycling	$204 745	$71 706	$133 039
Incineration			
Landfill	$705 854		$705 854
TOTAL	$910 598	$71 706	$838 892
INCREMENTAL POLICY IMPLEMENTATION	**Capital**	**Operating**	**Total**
PRODUCT SPECIFICATIONS			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)			
2000 COSTS OF WASTE MANAGEMENT	**Costs**	**Revenues**	**Net**
Reduction			
Reuse			
Recycling	$393 487	$127 085	$266 402
Incineration			
Landfill	$673 428		$673 428
TOTAL	$1 066 915	$127 085	$939 830
INCREMENTAL POLICY IMPLEMENTATION	**Capital**	**Operating**	**Total**
PRODUCT SPECIFICATIONS			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		74%	18%	8%		87%	6%
Fine Paper			33%	67%			60%	40%
Boxboard			20%	80%			50%	50%
OCC			10%	90%			15%	85%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		34%	65%	2%		50%	48%
Plastic (rigid and film)	-14%		6%	107%	-74%		41%	133%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		36%	33%	34%		42%	24%
Tinplate, Steel Cans	-26%		80%	46%	-16%		87%	29%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		21%	77%	-5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		38%		54%	5%		43%		52%
Fine Paper	11%		20%		69%	29%		30%		41%
Boxboard	1%				99%	-2%				102%
OCC	1%		40%		59%	-2%		61%		41%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		23%		75%			26%		74%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		42%		36%	26%		42%		32%
Tinplate, Steel Cans	-57%		43%		114%	-48%		50%		98%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	87 329	90 755
Reuse				
Recycled		232 562	680 958	1 293 072
Landfill	3 915 076	3 811 163	3 463 702	3 217 226
Total Diversion		242 037	768 287	1 383 827
Percent Diversion	0%	6%	18%	30%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			126 451	75 565
Reuse				
Recycled		241 693	652 751	1 187 658
Incineration				
Landfill	5 178 308	5 119 307	4 870 469	4 723 638
Total Diversion		241 693	779 202	1 263 223
Percent Diversion	0%	5%	14%	21%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 454 229	2 707 669
Recycled		474 255	1 333 709	2 480 730
Incineration				
Landfill		30 243	120 520	226 939
Total Diversion		474 255	1 333 709	2 480 730
Percent Diversion	0%	94%	92%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 334 171	7 940 864
Incineration				
Landfill	9 093 384	8 930 470	8 334 171	7 940 864
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 547 489	2 647 050
Percent of Waste Diverted	0%	5%	16%	25%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$226 605	$87 527	$139 079
Incineration			
Landfill	$700 082		$700 082
TOTAL	$926 688	$87 527	$839 161

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
RECYCLED CONTENT REGULATION			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$423 007	$147 394	$275 612
Incineration			
Landfill	$667 044		$667 044
TOTAL	$1 090 050	$147 394	$942 656

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
RECYCLED CONTENT REGULATION			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		74%	18%	8%		86%	7%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			1%	99%			2%	98%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-14%		6%	107%	-74%		41%	133%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	6%		21%	73%	8%		57%	35%
Food Waste	12%		2%	86%	22%		7%	71%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		32%		60%	5%		30%		65%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%				99%	-2%				102%
OCC	1%		30%		69%	-2%		51%		51%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		21%		77%			20%		80%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	135 103	152 488
Reuse				
Recycled		232 562	649 802	1 249 966
Landfill	3 915 076	3 811 163	3 447 085	3 198 599
Total Diversion		242 037	784 904	1 402 454
Percent Diversion	0%	6%	19%	30%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			126 451	75 565
Reuse				
Recycled		241 693	564 750	1 069 924
Incineration				
Landfill	5 178 308	5 119 307	4 958 470	4 841 372
Total Diversion		241 693	691 201	1 145 489
Percent Diversion	0%	5%	12%	19%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 328 934	2 538 396
Recycled		474 255	1 214 552	2 319 890
Incineration				
Landfill		30 243	114 382	218 506
Total Diversion		474 255	1 214 552	2 319 890
Percent Diversion	0%	94%	91%	91%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 405 555	8 039 971
Incineration				
Landfill	9 093 384	8 930 470	8 405 555	8 039 971
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 476 105	2 547 943
Percent of Waste Diverted	0%	5%	15%	24%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$204 745	$71 706	$133 039
Incineration			
Landfill	$706 079		$706 079
TOTAL	$910 823	$71 706	$839 117

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
SUBSIDISED HOME COMPOSTERS	$430		$430
TOTAL IMPLEMENTATION COSTS	$430		$430

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$393 487	$127 085	$266 402
Incineration			
Landfill	$675 369		$675 369
TOTAL	$1 068 856	$127 085	$941 771

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
SUBSIDISED HOME COMPOSTERS	$1 370		$1 370
TOTAL IMPLEMENTATION COSTS	$1 370		$1 370

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%		76%	17%	8%		87%	6%
Fine Paper			25%	75%			50%	50%
Boxboard			24%	76%			55%	45%
OCC			21%	79%			51%	49%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	13%		9%	78%	16%		34%	50%
Glass Containers	1%	7%	45%	47%	2%	10%	52%	36%
Plastic (rigid and film)	-14%		10%	104%	-74%		53%	120%
Composite Packaging	6%			94%	12%			88%
Aluminium Cans, Foil	30%		43%	27%	34%		44%	22%
Tinplate, Steel Cans	-26%		91%	36%	-16%		93%	23%
White Goods				100%				100%
Used Tires		2%	15%	83%		4%	3%	93%
Yard Waste	2%		21%	77%	5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	19%			81%	22%			78%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

	1992					2000				
ICI	Reduction	Reuse	Recycle	Incineration	Landfill	Reduction	Reuse	Recycle	Incineration	Landfill
ONP	8%		38%		54%	5%		37%		58%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%		5%		94%	-2%		10%		91%
OCC	1%		40%		59%	-2%		64%		38%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	15%				85%	23%				77%
Glass Containers	2%	4%	28%		66%		8%	36%		56%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		43%		35%	26%		45%		29%
Tinplate, Steel Cans	-57%		55%		102%	-48%		68%		79%
White Goods					100%					100%
Used Tires		2%	28%		70%	-2%	2%	64%		37%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	19%				81%	22%				78%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992			2000		
Solid Waste Management	Recycle	Inciner-ation	Landfill	Recycle	Inciner-ation	Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

	1992			2000		
Recycling	Recycle	Inciner-ation	Landfill	Recycle	Inciner-ation	Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	93 525	101 883
Reuse			18 977	31 935
Recycled		232 562	742 102	1 366 478
Landfill	3 915 076	3 811 163	3 377 386	3 100 757
Total Diversion		242 037	854 603	1 500 296
Percent Diversion	0%	6%	20%	33%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			127 300	77 282
Reuse			4 061	7 092
Recycled		241 693	657 855	1 195 873
Incineration				
Landfill	5 178 308	5 119 307	4 860 455	4 706 614
Total Diversion		241 693	789 216	1 280 247
Percent Diversion	0%	5%	14%	21%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 526 385	2 795 104
Recycled		474 255	1 399 957	2 562 352
Incineration				
Landfill		30 243	126 428	232 752
Total Diversion		474 255	1 399 957	2 562 352
Percent Diversion	0%	94%	92%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 237 841	7 807 371
Incineration				
Landfill	9 093 384	8 930 470	8 237 841	7 807 371
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 643 819	2 780 543
Percent of Waste Diverted	0%	5%	17%	26%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse	$4 299	$3 546	$752
Recycling	$237 119	$91 006	$146 113
Incineration			
Landfill	$691 990		$691 990
TOTAL	$933 408	$94 552	$838 856

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
SUBSIDIES TO PRODUCERS		$3 867	$3 867
TOTAL IMPLEMENTATION COSTS		$3 867	$3 867

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse	$7 497	$6 185	$1 312
Recycling	$436 537	$152 853	$283 685
Incineration			
Landfill	$655 830		$655 830
TOTAL	$1 099 865	$159 038	$940 827

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
SUBSIDIES TO PRODUCERS		$5 282	$5 282
TOTAL IMPLEMENTATION COSTS		$5 282	$5 282

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		76%	16%	8%		87%	5%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			21%	79%			51%	49%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		38%	60%	2%		52%	46%
Plastic (rigid and film)	-14%		14%	99%	-74%		52%	122%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		43%	27%	34%		43%	23%
Tinplate, Steel Cans	-26%		88%	38%	-16%		92%	24%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	25%		21%	54%	27%		57%	16%
Food Waste	19%		2%	78%	32%		7%	61%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	30%			70%	43%			57%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		32%		60%	5%		30%		65%
Fine Paper	11%		20%		69%	29%		35%		36%
Boxboard	1%				99%	-2%				102%
OCC	1%		40%		59%	-2%		64%		38%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		30%		68%			26%		74%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		39%		38%	26%		44%		30%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	13%		18%		69%	24%		29%		47%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	338 519	402 306
Reuse				
Recycled		232 562	724 639	1 357 133
Landfill	3 915 076	3 811 163	3 168 831	2 841 614
Total Diversion		242 037	1 063 158	1 759 439
Percent Diversion	0%	6%	25%	38%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			188 934	214 596
Reuse				
Recycled		241 693	644 671	1 193 895
Incineration				
Landfill	5 178 308	5 119 307	4 816 066	4 578 369
Total Diversion		241 693	833 605	1 408 492
Percent Diversion	0%	5%	15%	24%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 491 702	2 780 855
Recycled		474 255	1 369 310	2 551 028
Incineration				
Landfill		30 243	122 391	229 826
Total Diversion		474 255	1 369 310	2 551 028
Percent Diversion	0%	94%	92%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	7 984 897	7 419 984
Incineration				
Landfill	9 093 384	8 930 470	7 984 897	7 419 984
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 896 763	3 167 930
Percent of Waste Diverted	0%	5%	19%	30%

Source: Waste Management Policy Model

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

1992 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$233 670	$93 904	$139 767
Incineration			
Landfill	$670 743		$670 743
TOTAL	$904 413	$93 904	$810 509

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
USER CHARGES			
TOTAL IMPLEMENTATION COSTS			

COSTS OF ACHIEVING DIVERSIONS (000's of 1989$)

2000 COSTS OF WASTE MANAGEMENT	Costs	Revenues	Net
Reduction			
Reuse			
Recycling	$437 210	$159 452	$277 758
Incineration			
Landfill	$623 289		$623 289
TOTAL	$1 060 499	$159 452	$901 048

INCREMENTAL POLICY IMPLEMENTATION	Capital	Operating	Total
USER CHARGES			
TOTAL IMPLEMENTATION COSTS			

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%		75%	18%	8%		86%	6%
Fine Paper			29%	71%			53%	47%
Boxboard			23%	77%			52%	48%
OCC	5%		1%	94%	7%		2%	91%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%	3%	34%	62%	2%	3%	48%	48%
Plastic (rigid and film)	-14%		6%	107%	-74%		41%	133%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		31%	39%	34%		38%	28%
Tinplate, Steel Cans	-26%		77%	49%	-16%		84%	32%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		21%	77%	5%		57%	38%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other	5%			95%	5%			95%

	1992					2000				
ICI	Reduction	Reuse	Recycle	Inciner-ation	Landfill	Reduction	Reuse	Recycle	Inciner-ation	Landfill
ONP	8%		41%		51%	5%		43%		52%
Fine Paper	11%		24%		65%	29%		30%		41%
Boxboard	1%		10%		89%	-2%		15%		86%
OCC	1%		37%		62%	-2%		56%		46%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		23%		75%			23%		77%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		42%		36%	26%		42%		32%
Tinplate, Steel Cans	-57%		41%		115%	-48%		49%		99%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%				98%	-1%				101%
Food Waste	1%		18%		81%	-2%		29%		73%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other	5%				95%	5%				95%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992			2000		
Solid Waste Management	Recycle	Inciner-ation	Landfill	Recycle	Inciner-ation	Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

	1992			2000		
Recycling	Recycle	Inciner-ation	Landfill	Recycle	Inciner-ation	Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

	1987	1989	1992	2000
RESIDENTIAL				
Generation	3 915 076	4 053 200	4 231 989	4 601 053
Reduction		9 475	145 180	155 995
Reuse			9 480	7 975
Recycled		232 562	671 291	1 265 030
Landfill	3 915 076	3 811 163	3 406 038	3 172 053
Total Diversion		242 037	825 951	1 429 000
Percent Diversion	0%	6%	20%	31%
INDUSTRIAL/COMMERCIAL/INSTITUTIONAL (ICI)				
Generation	5 178 308	5 361 000	5 649 671	5 986 861
Reduction			179 955	132 262
Reuse				
Recycled		241 693	688 377	1 213 845
Incineration				
Landfill	5 178 308	5 119 307	4 781 339	4 640 754
Total Diversion		241 693	868 332	1 346 107
Percent Diversion	0%	5%	15%	22%

	1987	1989	1992	2000
RECYCLING				
Received		504 498	1 482 738	2 707 438
Recycled		474 255	1 359 668	2 478 874
Incineration				
Landfill		30 243	123 070	228 564
Total Diversion		474 255	1 359 668	2 478 874
Percent Diversion	0%	94%	92%	92%
SOLID WASTE MANAGEMENT				
Received for Disposal	9 093 384	8 930 470	8 187 377	7 812 807
Incineration				
Landfill	9 093 384	8 930 470	8 187 377	7 812 807
Sent to Recycling				
Percent Diversion	0%	0%	0%	0%
SUMMARY - ALL WASTE				
Total Waste Generated	9 093 384	9 414 200	9 881 660	10 587 914
Total Waste Diverted		483 730	1 694 283	2 775 106
Percent of Waste Diverted	0%	5%	17%	26%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

	1992				2000			
Residential	Reduction	Reuse	Recycle	Landfill	Reduction	Reuse	Recycle	Landfill
ONP	8%		74%	18%	8%		86%	7%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			1%	99%			2%	98%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-14%		6%	107%	-74%		41%	133%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		40%	57%	5%		80%	15%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

	1992					2000				
ICI	Reduction	Reuse	Recycle	Incineration	Landfill	Reduction	Reuse	Recycle	Incineration	Landfill
ONP	8%		32%		60%	5%		30%		65%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%				99%	-2%				102%
OCC	1%		30%		69%	-2%		51%		51%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		21%		77%			20%		80%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%		10%		89%	-1%		25%		76%
Food Waste	1%		25%		74%	-2%		44%		58%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Residential	1992 Reduction	1992 Reuse	1992 Recycle	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Landfill
ONP	8%		74%	18%	8%		86%	7%
Fine Paper			25%	75%			50%	50%
Boxboard			20%	80%			50%	50%
OCC			1%	99%			2%	98%
Mixed Paper				100%				100%
Magazines			9%	91%			28%	72%
Telephone Books	9%		9%	82%	9%		34%	57%
Glass Containers	1%		31%	68%	2%		46%	52%
Plastic (rigid and film)	-14%		6%	107%	-74%		41%	133%
Composite Packaging				100%				100%
Aluminium Cans, Foil	30%		28%	42%	34%		35%	31%
Tinplate, Steel Cans	-26%		74%	52%	-16%		82%	34%
White Goods				100%				100%
Used Tires				100%				100%
Yard Waste	2%		40%	57%	5%		80%	15%
Food Waste	8%		2%	90%	16%		7%	77%
Wood Waste				100%				100%
Construction/Demolition Waste				100%				100%
Disposable Diapers	15%			85%	15%			85%
Foundry Sands				100%				100%
Asphalt				100%				100%
Other				100%				100%

ICI	1992 Reduction	1992 Reuse	1992 Recycle	1992 Incineration	1992 Landfill	2000 Reduction	2000 Reuse	2000 Recycle	2000 Incineration	2000 Landfill
ONP	8%		32%		60%	5%		30%		65%
Fine Paper	11%		12%		77%	29%		20%		51%
Boxboard	1%				99%	-2%				102%
OCC	1%		30%		69%	-2%		51%		51%
Mixed Paper			19%		81%	-2%		18%		84%
Magazines	1%				99%	-1%				101%
Telephone Books	9%				91%	9%				91%
Glass Containers	2%		21%		77%			20%		80%
Plastic (rigid and film)	-14%		11%		104%	-77%		40%		137%
Composite Packaging					100%					100%
Aluminium Cans, Foil	22%		37%		41%	26%		36%		38%
Tinplate, Steel Cans	-57%		37%		120%	-48%		42%		106%
White Goods					100%					100%
Used Tires			16%		84%	-2%		62%		40%
Yard Waste	2%		10%		89%	-1%		25%		76%
Food Waste	1%		25%		74%	-2%		44%		58%
Wood Waste	1%		12%		87%	-2%		20%		81%
Construction/Demolition Waste	34%		25%		41%	42%		37%		22%
Disposable Diapers	15%				85%	15%				85%
Foundry Sands	5%		1%		94%	10%		27%		62%
Asphalt					100%					100%
Other					100%					100%

Source: Waste Management Policy Model

Waste Diversion Percentages by Sector and Component

Solid Waste Management	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP			100%			100%
Fine Paper			100%			100%
Boxboard			100%			100%
OCC			100%			100%
Mixed Paper			100%			100%
Magazines			100%			100%
Telephone Books			100%			100%
Glass Containers			100%			100%
Plastic (rigid and film)			100%			100%
Composite Packaging			100%			100%
Aluminium Cans, Foil			100%			100%
Tinplate, Steel Cans			100%			100%
White Goods			100%			100%
Used Tires			100%			100%
Yard Waste			100%			100%
Food Waste			100%			100%
Wood Waste			100%			100%
Construction/Demolition Waste			100%			100%
Disposable Diapers			100%			100%
Foundry Sands			100%			100%
Asphalt			100%			100%
Other			100%			100%

Recycling	1992 Recycle	1992 Inciner-ation	1992 Landfill	2000 Recycle	2000 Inciner-ation	2000 Landfill
ONP	95%		5%	95%		5%
Fine Paper	96%		4%	96%		4%
Boxboard	92%		8%	92%		8%
OCC	95%		5%	95%		5%
Mixed Paper	96%		4%	96%		4%
Magazines	92%		8%	92%		8%
Telephone Books	92%		8%	92%		8%
Glass Containers	92%		8%	92%		8%
Plastic (rigid and film)	100%			100%		
Composite Packaging	92%		8%	92%		8%
Aluminium Cans, Foil	100%			100%		
Tinplate, Steel Cans	94%		6%	94%		6%
White Goods	92%		8%	92%		8%
Used Tires	92%		8%	92%		8%
Yard Waste	90%		10%	90%		10%
Food Waste	90%		10%	90%		10%
Wood Waste	88%		12%	88%		12%
Construction/Demolition Waste	40%		60%	40%		60%
Disposable Diapers	92%		8%	92%		8%
Foundry Sands	92%		8%	92%		8%
Asphalt	92%		8%	92%		8%
Other	92%		8%	92%		8%

Source: Waste Management Policy Model

Appendix D Accounting relationships and definitions of the macroeconomic impact model

Accounting relationships of the macro economic impact model

D.1 The model

Recycling, reusing and other waste management activities involve the use of scarce resources and the generation of outputs and services. Typically, these activities were either neglected, mis-allocated or subsumed within other activities of other sectors within the standard input output accounting framework. Any attempt to focus on these activities calls for a major reformulation of the standard accounting framework. The adjustment process involves not only broadening the Use (input), Make (output) and Final Demand matrices of the rectangular input-output framework to encompass new commodities and industries, but also redefining the entire accounting relationships governing the system.

Three basic matrices define the structure of the traditional system: a "Make" matrix, V, a "Use" matrix, U, and a final demand matrix, F. The new adjusted system starts with these typical matrices. Adjustments and changes are made to each one in a manner that preserves consistency across all the component parts.

D.1.1 The adjusted Use matrix

The typical element of the Use matrix, U_{ij}, represents the value of commodity i used in production by industry j. The usual categories of primary inputs include: non-competitive imports, indirect taxes, labour income including benefits, net income of unincorporated business and other operating surplus.

Introducing the waste management activities explicitly into the overall production framework results in two basic changes to the structure of the Use matrix. First, many new producible inputs will be allotted new rows in the matrix. These are the recyclable materials and services provided by the waste management and environmental protection industries (EPI). The adjusted use matrix is expanded and dis-aggregated to show explicitly scrap, recycled materials, RM, recycled products and waste treatment and disposal services, CSTP. Second, the primary input matrix is expanded and reorganized to included the use of renewable and non-renewable resources extracted directly from the environment, VA.

D.1.2 The adjusted Make matrix

The typical element of the Make matrix, V_{ij}, is the value of commodity i produced by industry j. Thus each industry may, and typically does, produce more than one commodity. The Make matrix V has as many rows as there are commodities, and as many columns as there are industries. The incorporation of the environmental perspective necessitates the reformulation of the traditional Make matrix in a way that allows the production of recycled materials, RM, and the management of waste, WM. The changes that follow from this will be summarized below.

D.1.3 The adjusted Final Demand matrix

Final demand whose typical entry, F_{is}, defines the deliveries of commodity i to final demand category s (consumption, investment, government expenditures, exports to other provinces, and exports to the rest of the world). Several adjustments are needed to introduce the waste management - environmental linkages to final demand. First, households, institutions and government both generate recyclable materials, WM, in their waste and use recyclable products and their activities and choices influence the operations and activity levels of producers. Second, business investment is allowed to create capacity for the future production of recyclable products. The environmental perspective is typically long term and the system is made dynamic by linking business investment to output increases.

The organization of these matrices before and after incorporating the waste management activities are presented in Table D-1, Table D-2 and Table D-3, respectively.

Table D-1
Traditional input/output system

	Commodities	Industries	Final demand	Row Total
Commodities		U	F	q + m
Industries	V			g
Primary inputs		Y	Y^F	y^T
Column Total	q'	g'	F	T

A presentation of the accounting relationships of the model are provided below.

D.2 The accounting identities

The following is an explanation of the accounting relationships within the macroeconomic input output model used for this study.

The following 18 identities depict in algebraic form the accounting structures.

1) $\Sigma_j V_{ij} = q_i$

Commodity i is produced by many industries.

2) $\Sigma_l RM_{kl} = RM_k$

Recycled material k is produced by waste material processing and is used only by industries. It may be a substitute for virgin inputs.

3) $\Sigma_j WM_{kj} + \Sigma_f WM_{kf} = WM_k$

Waste material is produced by industries, households and institutions.

Table D-2
Adjusted Use (input) matrix

	Industries	Waste material processing	Waste management	Final demand	Row Total
Commodities	U_{ij}	U_{il}	U_{icstp}	F_{is}	$q_i + m_i$
Recycled material	RM_{kj}				$RM_k + m_k$
Recycled waste		WM_{kj}			$WM_k + mw_k$
C/S/T/P services	$CSTP_j$	$CSTP_l$		$CSTP_S$	$q_{cstp} + m_{cstp}$
Charges for non-renewable inputs	RN_j	RN_l	RN_{cstp}	RN_S	RN_t
Value added	VA_{jR}	VA_l^R	VA_{cstp}^R	VA_S^R	VA_T^R
Column Total	g_j	g_i	g_{cstp}	F_S	

4) $CSTP = q_{cstp}$

Collection, sorting, transportation and environmental protection services are defined as a single specific and unique service.

5) $\Sigma_i V_{ij} + \Sigma_k WM_{kj} = g_j$

Industries produce commodities and waste products. Usually, waste products are valued at a zero price. If a zero price is assigned to them, only commodities are counted as outputs of industries.

6) $\Sigma_k RM_{kl} = g_l$

Recycled materials are produced by specific waste material processing industries.

Table D-3
Adjusted Make (output) matrix

	Industries	Waste material processing	C/S/T/P	Final demand	Row total
Commodities	V_{ij}				q_i
Recycled material		RM_{kl}			RM_k
Recyclable waste	WM_{kj}	Y	Y^F	WM_S	WM_k
Collect/sort/ transport/ process			CSTP		q_{cstp}
Column Total	g_j	g_l	g_{cstp}	WM_S	

7) $CSTP = g_{cstp}$

Waste management and environmental protection products and services add to the total output of this industry.

8) $\Sigma_k WM_{ks} = WM_s$

Waste generated by households and institutions is added together under final demand.

9) $\Sigma_j U_{ij} + \Sigma_l U_{il} + U_{i\,cstp} + \Sigma_s F_{is} = q_i + m_i$

This equation represents the commodity balance (Supply = Demand) for commodity i. Supply is made of domestic production (q_i) and imports (m_i). Demand comprises intermediate and final demands for commodity i.

10) $\Sigma_j RM_{kj} = RM_k + m_{rk}$

Recycled materials are delivered to industries. The total industrial demand is satisfied by domestic production and imports (m_{rk}).

11) $\Sigma_l WM_{kl} = WM_k + m_{wk}$

Recyclable waste materials are delivered to waste material processing industries. The total demand by the recycling industries is equal to production of recyclable materials plus net imports (m_{wk}).

12) $\Sigma_j CSTP_j + \Sigma_l CSTP_l + \Sigma_s CSTP_s = q_{cstp} + m_{cstp}$

Waste management services and environmental protection services' demand by regular industries, recycling industries and final demand categories must equal available domestic production of these services plus imports (m_{cstp}).

13) $\Sigma_j RN_j + \Sigma_l RN_l + RN_{cstp} + \Sigma_s RN_s = RN_T$

The use and depletion of non-renewable resources is charged as a cost against output of each of the respective industries. Non-renewable resources are treated here as if they were non-competing imports. They are in a sense imported from the environment.

14) $\Sigma_j VA_j^R + \Sigma_l VA_l^R + VA_{cstp}^R + \Sigma_s VA_s = VA_T^R$

Value added is treated as the sum of factor payments that are left after paying for intermediate inputs and the charges for non-renewable resources.

15) $\Sigma_i U_{ij} + \Sigma_k RP_{kj} + CSTP_j + RN_j + VA_j^R = g_j$

The total value of inputs used to produce output j is equal to the value of that output. This follows from treating value added as a residual item.

16) $\Sigma_i U_{il} + \Sigma_k WM_{kl} + CSTP_l + RN_l + VA_l^R = g_l$

The output of waste material processing and cstp industries fully cost out.

17) $\Sigma_i U_{icstp} + NR_{cstp} + VA_{cstp}^R = g_{cstp}$

18) $\Sigma_i F_{is} + CSTP_s + NR_s + VA_s^R = F_s$

D.3 Matrix hypotheses of the model

There is a logical order to the hypotheses of the model. The following is a discussion of the Make matrix conditions, the hypotheses of the Use matrix and the Final Demand system.

D.3.1 Market structure

19) $V_{ij} = d_{ij} q_i$

Where d_{ij}'s represent the fixed market share of industry j in the production of commodity i. This assumption, together with the Industry Output identity (5), implies that industry gross outputs can be calculated from commodity output assuming, for convenience, that waste products are assigned a zero price. We have :

20) $g_j = \Sigma_i V_{ij} = \Sigma_i d_{ij} q_i$

Thus the vector of industry gross outputs {g}, is related to the vector of commodity outputs {q}, by the following matrix equation:

21) $\{g\} = [D] \{q\}$

Where { } indicates a column vector and [ ] indicates a matrix of coefficients.

Equation (21) indicates that the fixed market share assumption implies that the production of the j^{th} (multi-product) industry is a weighted sum of the commodity outputs which it produces, where the weights are the coefficients d_{ij}: These weights sum to one across industries. Since $q_i = \Sigma_j V_{ij} = \Sigma_j d_{ij} q_i$, it follows that:

22) $\Sigma_j d_{ij} = 1$ for i=1,2,3,....,n.

Waste generation by type of waste or pollutant k is linked to employment in industry j. But since employment is linked by fixed employment-output coefficients, we establish a direct and fixed link to industry gross outputs g_j by equation 23 below:

23) $WM_{kj} = w_{kj} g_j$

Where w_{kj} are waste (pollutants) of type k measured by physical units per $1000 of industry j output. w_{kj} could be ONP tonnes per $1000 worth of output of industry j.

Waste and pollutants are also generated by households and the institutional sectors. This type of waste generation is related to Final Demand categories directly.

24) $WM_{ks} = w_{ks}F_s$

Finally,

25) $RM_{kl} = r_{kl}\ RM_k$

Equation (25) establishes a market share for recycling industry l in the production of the k^{th} recycled material.

D.3.2 Industry-production function hypotheses

The production function underlying most of the production processes of the system is assumed to be of the fixed proportion type (generally known as a Leontief production function).

26) $g_i = \underset{i}{\text{Min}}\ [U_{ij}/b_{ij}]$ for $i=1,2,\ldots,n.$
$j=1,2,\ldots,m.$

Where $b_{ij} = U_{ij}/g_j$ is the amount of commodity i needed to produce one unit of output j. Thus, the use of each commodity is assumed to be a fixed proportion of industry gross output:

27) $U_{ij} = b_{ij}\ g_j$

Therefore, the following sets of equations hold:

28) $RM_{kj} = r_{kj}\ g_j$

29) $CSTP_j = cstp_j\ g_j$

30) $RN_j = rn_j\ g_j$

31) $VA_j^R = v_j\ g_j$

32) $U_{il} = b_{il}\ g_l$

33) $WM_{kl} = b_{kl} \cdot g_l$

34) $CSTP_l = cstp_l\ g_l$

35) $RN_l = rn_l\ g_l$

36) $VA_l = v_l\ g_l$

D.3.3 Final demand system

Final Demand categories include consumption, investment, government expenditures, exports and imports. Some are endogenously determined by being related to other components of the system, while some are purely exogenous to the system. In this model we treat consumption, investment and imports as endogenous variables.

When consumption is related to income, the household sector becomes a sort of producing sector whose output can be solved within the production system. Let,

37) $F_c = ßY$

Where F_c is total consumption, ß is the long-run Marginal Propensity to Consume, and Y is income.

Income is defined as the sum of Labour Income, W, and Net Income of Unincorporated Business, UIC. Thus, income is related to gross industry output by the vectors of primary input coefficients (components of value added) w and e.

38) $Y = \Sigma_j (w_j + e_j)\ g_j + \Sigma_l (w_l + e_l)\ g_l + (w_{cstp} + e_{cstp})\ g_{cstp} + (w_c + e_c)F_c + W^f$

Where W_f is the sum of Labour income associated with all final demand categories except consumption and competitive imports.

The integration of consumption into the model is completed by assuming that the values of commodities and primary inputs that enter into consumption expenditures are fixed proportions of the total value of consumption.

39) $Fc_i = c_i\ F_c$

or, in matrix-vector notation:

$\{F_c\} = \{c\}\ F_c$

Where c_i is the proportion of consumption used to purchase commodity i and {c} is the column vector of c_i's. Also,

40) $W_c = (w_c + e_c)\ F_c$

Where w_c is the proportion of the total value of consumption spent on Labour, and e_c is the proportion of the total value of consumption which generates net income of unincorporated business.

The income concept defined in (38) does not include dividends and government and private transfers and may, therefore, not accurately represent personal income. On the other hand, the

inclusion of dividends, government transfers and private transfers would require information on the distribution of dividends and transfers between Ontario, the other provinces, and abroad. This information is not available.

D.4 Definition of macroeconomic terms

The following is a list of some indicators of macroeconomic impacts and terms used in the macroeconomic analysis of the waste diversion scenarios.

Employment
Employment is the amount of labour time used in production, measured in person-years.

Labour income
Labour income equals the total value of wage and salary payments to employees.

Disposable Income
Disposable income is total income net of personal income taxes.

Consumption
The value of goods and services used by households.

Gross provincial income
Gross provincial income is the total value of payments to productive factors in the province. It represents the sum total of wages and salaries, interest payments, rent and profits.

Sales
Sales equal the total value of goods and services produced. It is also referred to as the value of shipments. It includes final as well as intermediate output.

Investment
Investment is spending on new capital goods, including equipment and structures and inventories.

Revenue
The definition of revenue used in this report is slightly different from the customary one. Revenue includes the total cost of operating a business plus net profits and depreciation. Taxes on corporate profits and on business and property are also included. The one item excluded is the payment of interest on loans.

Value added
Value added is a measure of net output which avoids double counting of products sold during the accounting period by including only final goods. For example, the final output, chairs are included, whereas the wood that goes into making them does not appear separately as a final output. Value added is equal to income (gross provincial income) and is calculated by adding together wages, interest, rent and profits. Alternatively, value added is equal to revenues minus the total cost of purchased inputs.

Wage value-added
Wage value-added is employment income associated with production.

Intermediate output
Is the output of the economy which will be used for further processing in the economy.

Final output
Final output are the outputs of the economy which will be used for further processing in the economy.

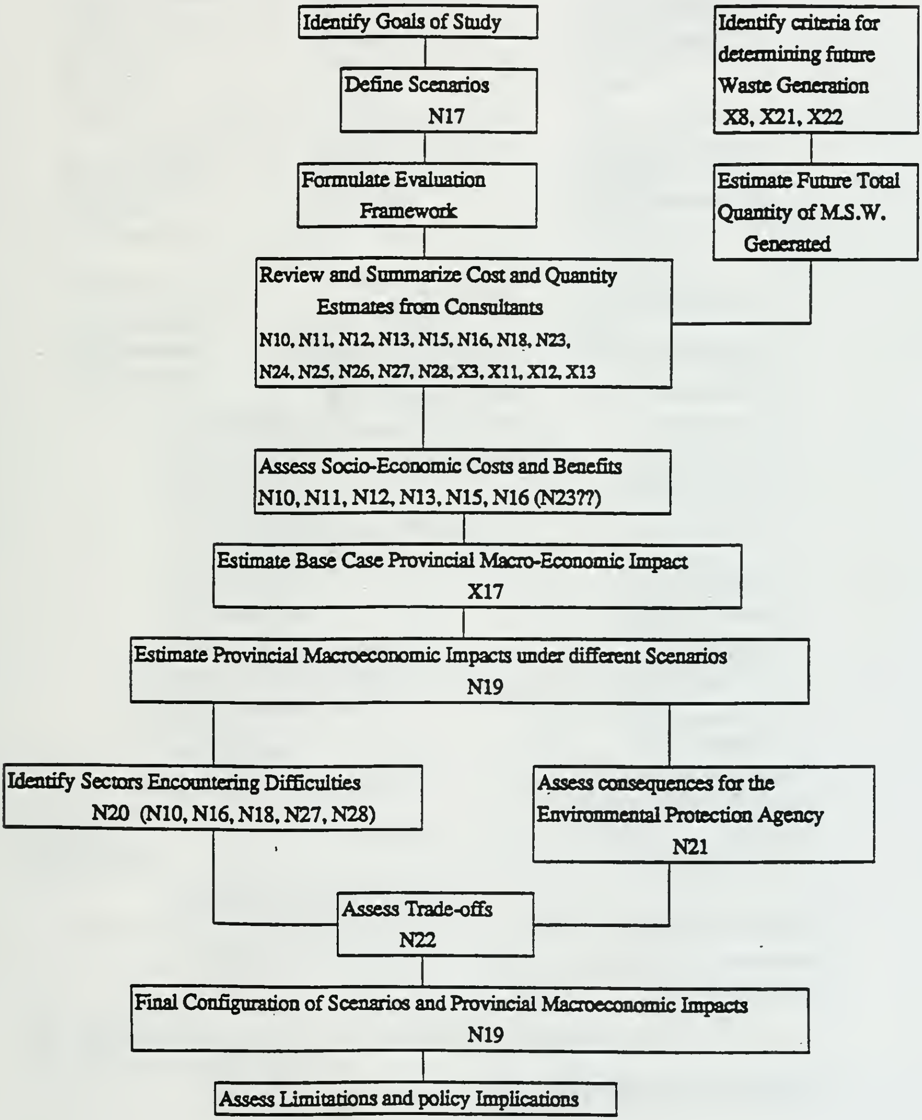
Multipliers
Multipliers are unitless measures calculated by adding direct, indirect and induced effects together and dividing this total by the original expenditure (revenue). For example, the income multiplier associated with a given project is equal to total income divided by the original revenue. The employment multiplier is calculated differently and is calculated by dividing total employment by direct employment. This difference is necessitated by the fact that the use of the general definition of multipliers for employment results in dividing employment in person years by dollars of revenue. The result is not unitless.

Thompson, K.M. and McBride, G.E. 1989. *Recycling and the Canadian pulp industry, part I, economic background to Paprican research on recycled paper.*

Appendix E Logic diagram of study components

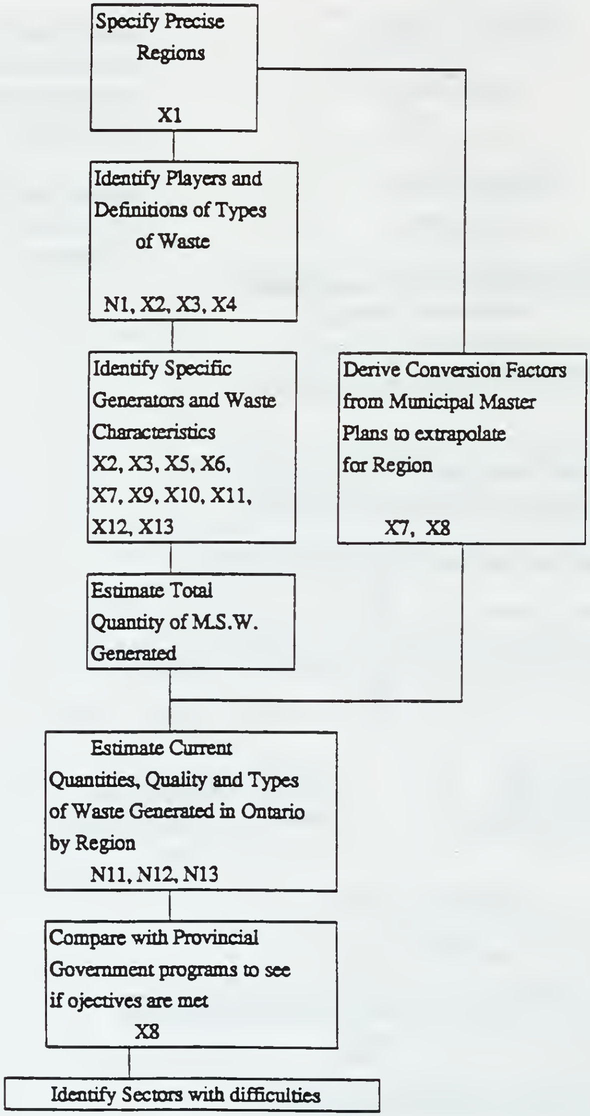
COORDINATION AND SYNTHESIS OF A SOCIO-ECONOMIC ASSESSMENT OF ONTARIO WASTE MANAGEMENT INITIATIVES

Consultants: VHB Research and Consulting/Econometrics Research Limited



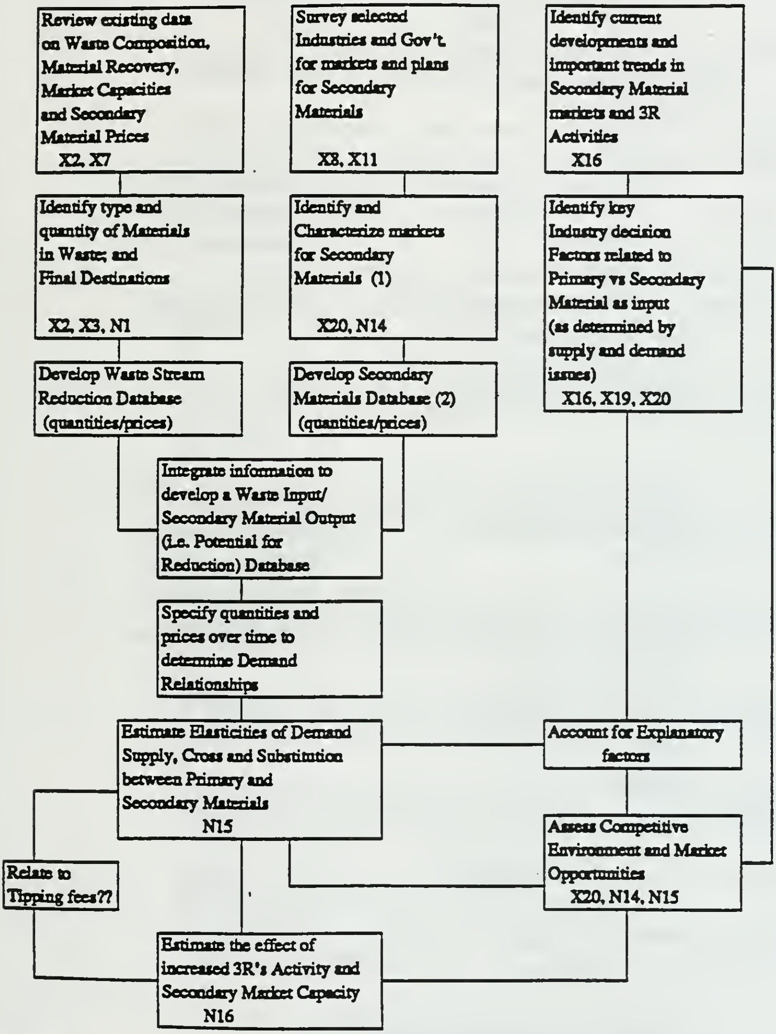
THE ECONOMIC AND PHYSICAL DIMENSIONS OF SOLID WASTE MANAGEMENT IN ONTARIO

Consultants: CH2M HILL and MacLAREN



MARKET ASSESSMENT OF 3R ACTIVITIES

Consultants: Resource Integration Systems/VHB Research & Consulting



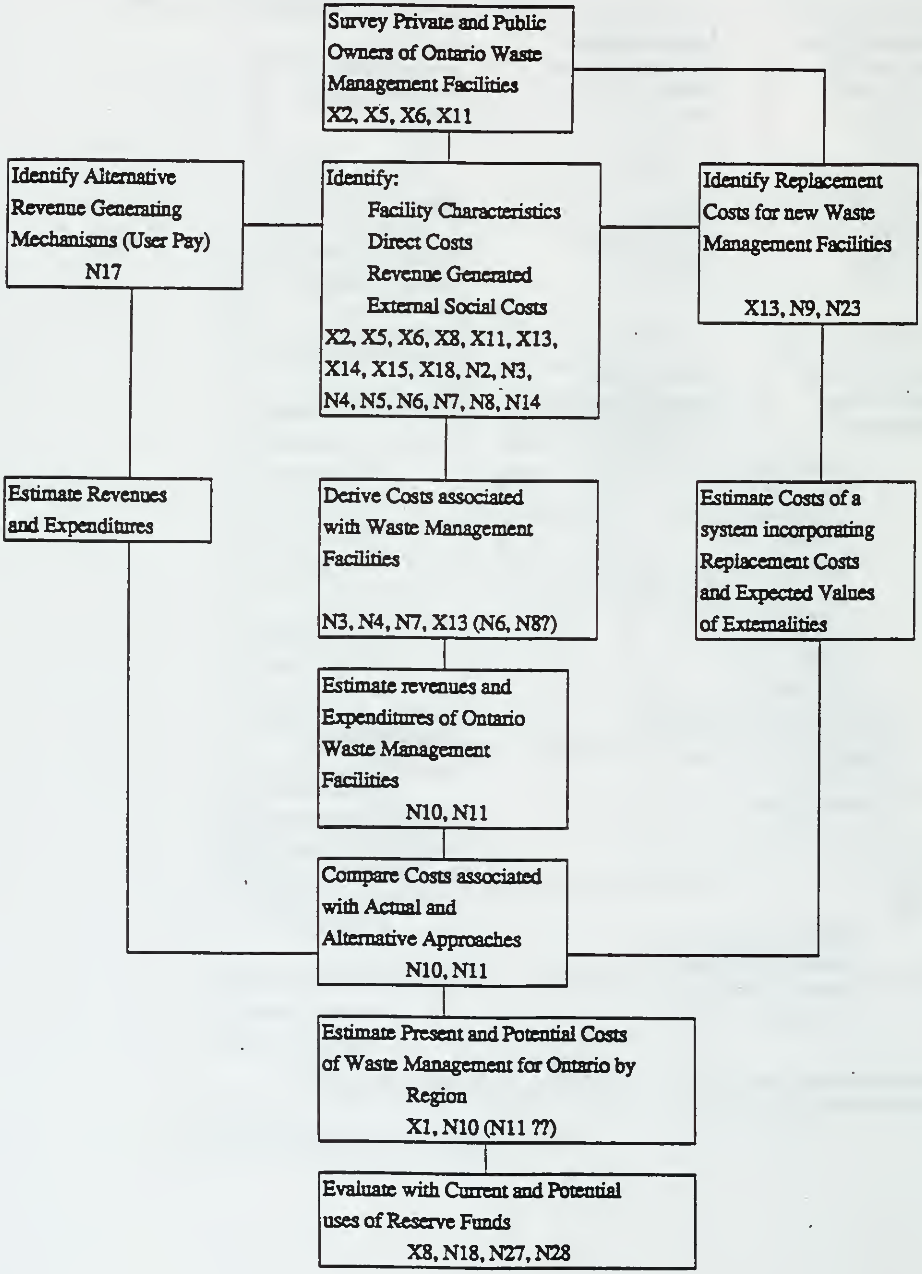
Notes:

(1) Based on number and location of firms, current and planned capacity, price ranges, etc..

(2) Extrapolated for non-respondents.

COST OF WASTE MANAGEMENT AND USER PAY MECHANISMS

Consultants: MacLaren Engineers/VHB Research and Consulting



ENDOGENOUSLY OBTAINED ANALYTICAL INPUTS (N)

All data on an annual basis (unless otherwise stated)

Dollars in $ 1987 dollars

1. List of designated types of waste, provided by the Steering Committee [STEERING COMMITTEE/RIS, CH^2M, ML, VHB][2]

2. Estimates of quantity and types of waste accepted (Base year: 1987) by Ontario waste management facilities (to be obtained from a survey of public and private operators of waste management facilities) [ML/ML, VHB]

3. Estimates of development and operating costs in previous year (to be obtained from a survey of public and private operators of waste management facilities) (dollars) [ML/ML (MacLaren has a large number of these estimates in-house)

4. Type of approval for waste management facilities and costs incurred for Regulatory activities, to be obtained municipalities and/or private operators [ML/ML

5. Existence and estimates of reserve funds, to be obtained from a survey public and private operators of waste management facilities (dollars) [MOE, ML/ML

6. Estimates of number of persons dislocated by facility, and living within *x* metres of facility, to be obtained from survey of public and private operators of waste management facilities [VHB/VHB] (Questionable)

7. Detection of any environmental degradation, to be obtained primarily from facility operators and MOE district offices (subsequently) [VHB/VHB]

8. Cost estimates for proposed and existing facilities to be obtained from private consultants (expertise in waste management) [VHB/VHB]

9. Estimate of the opportunity cost of land (if it was used for an alternative activity) (done by present value) [ML/VHB]

10. Estimate of the "true" costs of waste disposal in Ontario, by facility [ML/VHB]

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[2] First item in square brackets refers to team responsible for obtaining/producing input/output, second item refers to team that will make use of the input/output

11. Estimate of current quantities and value of waste generated in Ontario, by region (kg, tonnes, dollars - related to tipping fees)
[CH^2M, ML/VHB, ECON, RIS]

12. Estimate of current quantities of waste generated in Ontario, by region (% recyclable ?? - i.e. usefulness in another market) [CH^2M, ML/RIS, VHB]

13. Estimate of current types of waste generated in Ontario, by region (kg/capita, occupant, employee)
[CH^2M, ML/RIS, VHB]

14. Cost of repairing any environmental damage caused by a Waste Management facility, to be obtained from survey of public and private operators of waste management facilities [VHB/VHB]

15. Estimate of demand (trade-offs) due to prices and quantities between primary and secondary materials (dollars, kg, tonnes) [VHB/VHB

16. Estimates of impacts of waste disposal (types, quantity and tipping fees) and secondary markets, with increased 3R's activity (% composition, kg, tonnes, dollars)
[VHB (RIS ??)/VHB, ECON

17. As determined by pre-defined objectives of the MOE
[MOE, VHB/VHB

18. Estimates of municipal tipping fees (dollars)
[VHB/VHB]

19. Projected annual rates of growth, by sector, by region, adjusted for changes in output prices, waste quantities and secondary markets due to waste management initiatives (dollars, kg, tonnes, etc.) [VHB, ECON/ECON]

20. List of sectors (industries) and regions with potential problems
[ECON/ECON, VHB]

21. Estimate of total cost/benefit to EPA under proposed waste management initiatives (dollars)
[ECON/VHB]

22. Estimates of changes in costs and quantities under different scenarios, compared to base case, and compared to other scenarios [ECON/VHB

23. Closure costs of a Waste Management Facility, to be obtained from survey of public and private operators of waste management facilities [ML/ML, VHB]

EXOGENOUSLY OBTAINED ANALYTICAL INPUTS (X)

All data on an annual basis (unless otherwise stated)

Dollars in $ 1987 dollars

1. Regions and counties as defined by the Ministry of Municipal Affairs, in the 1989 Municipal Directory
[All Consultants]

2. List of MSW Disposal Facilities, Company Players, generation and fate of waste, provided by MOE Waste Management Branch (kg, tonnes)
[MOE/RIS, CH^2M, ML] [1]

3. List of, and economic data on, waste haulers in Ontario from GRDCA, NSWMA and Haulers Association (HA) (kg, tonnes, dollars) (Preliminary)
[GRDCA, NSWMA, HA, ML (MOE??)/CH^2M, RIS, ML]

4. Regional distribution of economic activity by SIC (1980 Edition) (from Scott's Directory of Industrial Facilities in Ontario)
[CH^2M, ML (MOE)/CH^2M, ML, ECON, VHB]

5. List of open and operating landfills in Ontario
[MOE/CH^2M, ML, VHB]

6. List of MSW incinerators in Ontario (from MOE and MacLaren in-house files)
[MOE, ML/CH^2M, ML]

7. Study by Gore & Storrie on the composition of the Residential component of MSW [MOE/CH^2M, ML, RIS, VHB]

8. From the 41 on-going Waste Management Master Plans (which gives the projected growth in waste, by category, by type, and population)
[MOE/CH^2M, ML, RIS, VHB, ECON]

9. Estimates of current population (obtained from Municipal Master Plans and Stats. Can. data) (thousands of persons) [MOE, CH^2M, ML/CH^2M, ML, VHB]

10. Estimates of current employment (obtained from Municipal Master Plans and Stats. Can. data) (thousands of persons) [MOE, CH^2M, ML/CH^2M, ML, VHB]

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[1] First item in square brackets refers to team responsible for obtaining/producing input/output, second item refers to team that will make use of the input/output

11. List of, and economic data, on Recyclers in Ontario from industry associations, and organizations such as RAC, OMMRI, in addition to MacLaren in-house files (kg, tonnes, dollars) [RAC, OMMRI, MOE, ML/RIS, ML, CH^2M]

12. Capacity of waste disposal facilities provided by MOE (tonnes) [MOE/ML, VHB

13. Equipment (used for incinerators, landfills, etc.) supplier prices (CND $ 1987) [VHB/VHB] (Questionable)

14. Number of complaints, with respect to waste management facilities, to be obtained from MOE district offices [VHB/VHB]

15. Rates for tipping fees, to be obtained from municipalities (by type, disposer, and over time) [ML/ML, VHB]

16. Information on current development in 3R's and secondary markets, available from SWEAP, OMMRI and RIS
[RIS/RIS]

17. Projected rate of growth by sector, by region, in the absence of any waste management initiatives [ECON/ECON]

18. Tax rates and Capital Cost Allowances, available from Revenue Canada and municipalities [VHB/VHB] (Questionable)

19. Information on Product Specifications and Standards of output, from Secondary materials [RAC ??/RIS]

20. List of firms, current and planned capacities, prices, etc., of markets for secondary materials [RIS/RIS]

21. Projections of population growth (obtained from Municipal Master Plans, Ministry of Treasury and Economics and Stats. Can. data) (thousands of persons)
[MOE, VHB, ECON/ECON, VHB]

22. Projections of employment growth (obtained from Municipal Master Plans, Stats. Can. data, and Conference Board projections) (thousands of persons)
[MOE, VHB, ECON/ VHB, ECON]

24. Estimate of future quantities and value of waste generated in Ontario, by region (kg, tonnes, dollars - related to tipping fees)
[VHB, ECON/VHB, ECON]

25. Estimate of future quantities of waste generated in Ontario, by region (% recyclable ?? - i.e. usefulness in another market)
[VHB, ECON/VHB, ECON, RIS]

26. Estimate of future types of waste generated in Ontario, by region (kg/capita, occupant, employee)
[VHB, ECON/VHB, ECON]

27. Estimates of User Fees charged by Waste Management Facility
[VHB/VHB]

28. Estimates of revenues raised in Reserve Funds by Waste Management Facility
[VHB/VHB]